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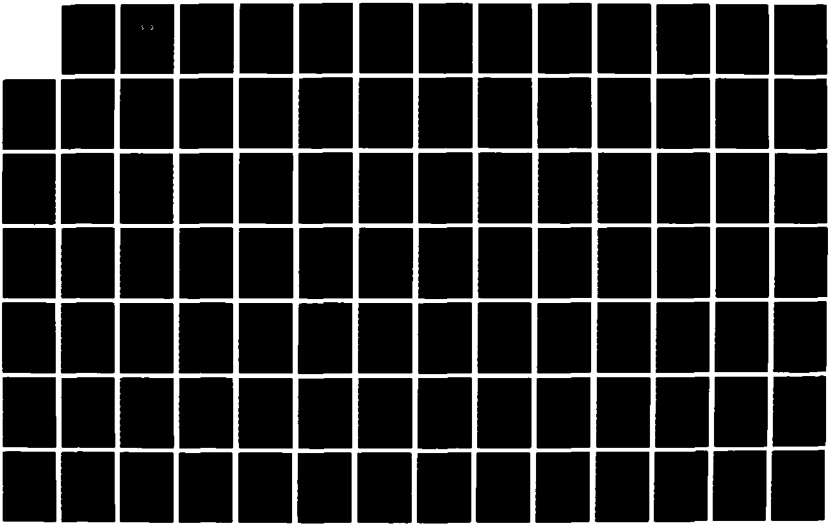

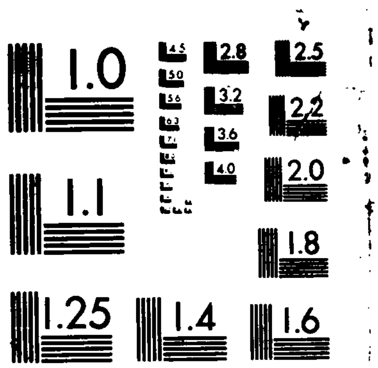

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Design of an Aircrew Scheduling
Decision Aid for the
6916th Electronic Security Squadron

THESIS

Thomas J. Kopf
Captain, USAF

AFIT/GST/ENS/87M-9

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Design of an Aircrew Scheduling Decision Aid for the 6916th Electronic Security Squadron

THESIS

Presented to the Faculty of the School of Engineering

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the

Requirements for the Degree of

Master of Science in Operations Research

Thomas J. Kopf, B.S.

Captain, USAF

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The aircrew scheduling problem has received considerable research attention in the military. Because of the great number of possible scheduling alternatives, it is difficult to find an optimal solution to the scheduling problem. Additionally, changes to the original schedule make it even more difficult to find an optimal solution. The emergence of capable microcomputers, decision support systems, the adaptive design methodology, and integrated software packages has provided an opportunity to develop decision aids to help aircrew schedulers become more efficient and develop more effective aircrew schedules. This thesis investigates the development of a decision aid to assist 6916ESS Electronic Security Squadron schedulers develop schedules and make changes to existing schedules. The adaptive design methodology in decision support systems development is used in the construction of this decision aid. "Storyboarding" and the Representation, Operations, Memory Aids, and Control Aids (ROMC) are two popular techniques ~~used~~ in the adaptive design process to define system requirements and the decision process and to select the important sub-problems or "kernels" as the starting point for system implementation. This decision aid integrates an extensive data base and spreadsheet system to assist schedulers develop and maintain schedules and other scheduler functions such as: flight orders preparation, 30 and 90 day flight hour computations, and recurring training. The system is built using a Zenith Z-248 microcomputer and an integrated word processing, spreadsheet, and data base software package.

Preface

The purpose of my research was to develop a decision aid that would actually be fielded at the 6916ESS and possibly other ESC airborne units and still meet the thesis academic requirements. The resulting decision aid can be improved in time with adherence to the adaptive design process.

While building this decision aid, I received support form several people which added substantially to the quality of the decision aid. SSgt Gene Salo from the 6916ESS fought the mail service between the US and Greece to validate my understanding of the scheduling process at the 6916ESS. LtCol French (Frenchy), HQ ESC/XPX found the time and TDY funding to send an expert to evaluate the early design and development of the decision aid. The expert, CMSgt Wally Knox provided valuable comments on the original design and future enhancements for the system. LtCol Skip Valusek provided solid guidance and almost a "free reign" as my thesis advisor. Maj Jim Schoeck was instrumental in helping me keep the proper perspective throughout my stay at AFIT. Last but by no means least, I heartfully appreciate the understanding and encouragement my wife, Sara, provided during this "crisis." To those mentioned here and to everyone else who helped with this undertaking, thank you.

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ABSTRACT

The aircrew scheduling problem has received considerable research attention in the military. Because of the great number of possible scheduling alternatives, it is difficult to find an optimal solution to the scheduling problem. Additionally, changes to the original schedule make it even more difficult to find an optimal solution. The emergence of capable microcomputers, decision support systems, the adaptive design methodology, and integrated software packages has provided an opportunity to develop decision aids to help aircrew schedulers become more efficient and develop more effective aircrew schedules. This thesis investigates the development of a decision aid to assist 6916ESS Electronic Security Squadron schedulers develop schedules and make changes to existing schedules. The adaptive design methodology in decision support systems development is used in the construction of this decision aid. "Storyboarding" and the Representation, Operations, Memory Aids, and Control Aids (ROMC) are two popular techniques used in the adaptive design process to define system requirements and the decision process and to select the important sub-problems or "kernels" as the starting point for system implementation. This decision aid integrates an extensive data base and spreadsheet system to assist schedulers develop and maintain schedules and other scheduler functions such as: flight orders preparation, 30 and 90 day flight hour computations, and recurring training. The system is built using a Zenith Z-248 microcomputer and an integrated word processing, spreadsheet, and data base software package.

Copyright Acknowledgement

DESIGN OF AN AIRCREW SCHEDULING DECISION AID FOR THE 6916TH ELECTRONIC SECURITY SQUADRON

I Background

Background

6916th Electronic Security Squadron (6916ESS). The 6916ESS is located at Hellenikon Air Base near Athens, Greece and is a subordinate squadron of Electronic Security Europe, Ramstein Air Base, Germany and Electronic Security Command, Kelly Air Force Base, Texas. The 6916ESS provides support to the US Navy's Sixth Fleet, US Air Forces in Europe, and to national command authorities. The squadron provides aircrew personnel in support of the RC-135V/W (Rivet Joint) mission. The specific mission of the 6916ESS is classified. For the purposes of this research, it is sufficient to say that 6916ESS personnel fly combat support missions on Strategic Air Command aircraft and that their missions are vital to national security and the safety of US forces in the Mediterranean area.

Due to the 6916ESS' mission load, crew scheduling is a daily requirement. The 6916ESS' missions are tasked by the Joint Chiefs of Staff and executed by the Strategic Air Command. Since practically every mission the 6916ESS flies is a combat support mission, emphasis is placed on providing an operationally qualified crew for each mission. Secondary emphasis is placed on the training of unqualified operators.

6916ESS personnel operate 12 standard positions and several special projects positions aboard the RC-135 aircraft. The

squadron is currently tasked to support two standing missions and contingency operations in the area. The 6916ESS flight crew is comprised of 19-20 operations personnel and three to four maintenance technicians. Thirteen to fourteen of these personnel are primary operators. The remaining five to seven personnel are trainees, evaluators, observers, or visitors. Depending on the mission being flown, there are either thirteen or nine unique positions that must be manned as shown in Table 1.1. Position 1, position 2, and position 13 are all special positions. Operators qualified in these special positions must also be qualified as a type 3, 4, 5, or 6 operator. The type 3 Lead, 4 Lead, 7 Lead, and 8 Lead operators are also qualified to fly the type 3, 4, 7 and 8 positions respectively. Due to the classification of the function of each position, further definition will not be given.

Table 1.1 Aircraft Position Layout

Mission Type 1

Position	5	2	1	3	4	6	7	8	9	10	11	12	13
Type of Operator	5	2	1	3 Lead	4 Lead	6	4	3	7 Lead	7	8	8 Lead	9

Mission Type 2

Position	5	2	1	3	4	6	7	8	9	10	11	12	13
Type of Operator	5	2	1	3 Lead	4 Lead	6	4 Lead	4	4	3	3	3 Lead	9

Organization

The 6916ESS Operations Branch is divided into 'day management' functions and flight operations (see Fig 1 below).

The major day management sections include: Collection Management (DOO), Training (DOT), Standardization/Evaluation (DOTS), Computer Resources (DOY), Support (DOU), and Analysis and Reporting (DOA). Flight operations is managed by the Operations Production (DOR) Section. DOR is responsible for ground processing and ensuring each mission is manned with a qualified crew. Therefore, the operations scheduling function is a DOR responsibility. DOR is composed of three flights, a special signals section, and the operations scheduling section.

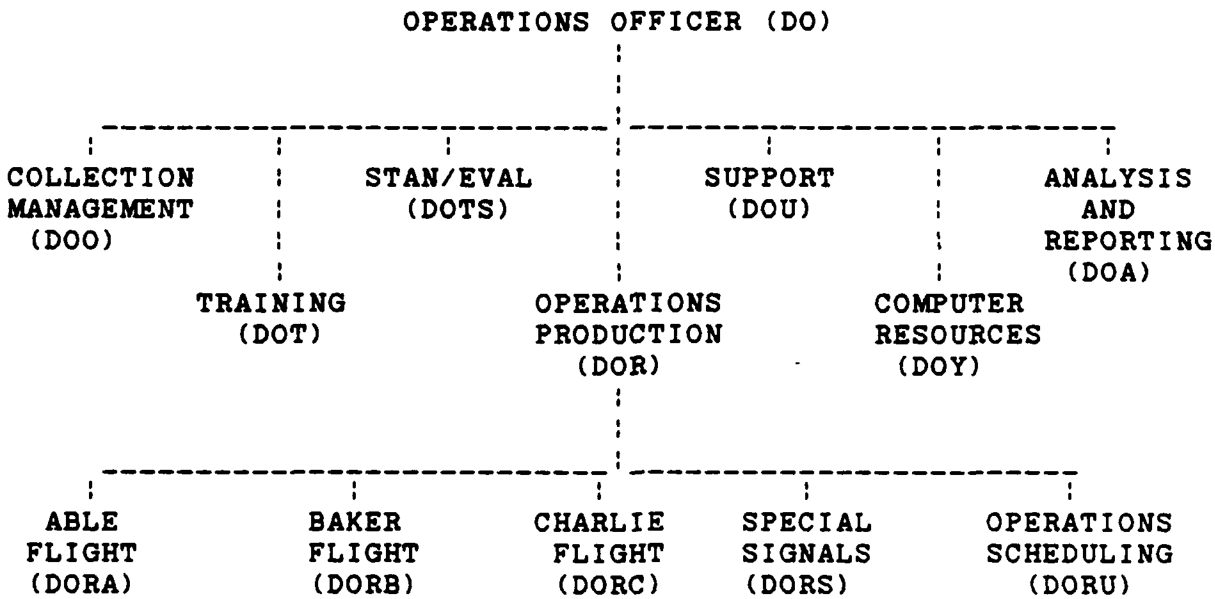

Figure 1.1 Operations Organization

Although actual manning levels vary, the 6916ESS is authorized approximately 120 flying personnel. Table 1.2 shows the division of the authorized personnel among the different type of operators and the average percent qualified. Since the actual number of personnel varies, no attempt is made to define the

actual number of personnel assigned or the number of qualified/unqualified personnel assigned to the 6916ESS.

Table 1.2 6916ESS Manning

Type of Operator	Number Authorized	Percent Qualified
3	30	35-50
4	30	35-50
5	10	70-80
6	10	70-80
7	20	35-50
8	20	35-50
Total	120	

Scheduling Constraints.

Squadron schedulers must schedule a qualified crew for every mission and provide trainees the opportunity to become fully qualified. They accomplish these tasks in the face of many constraints such as: the type of mission, number of seats, regulations, rotating shift schedule, training, mission schedule changes, crewrest, and absences. The schedulers consider each of these constraints during the scheduling process. Operator availability is the most significant constraint the scheduler must consider.

Operator Availability.

Numerous factors affect an operator's availability to fly any particular mission. Air Force regulations restrict operators from flying more than 125 hours in any 30 consecutive day period or more than 330 hours in any 90 consecutive day period. Air Force regulations also require 12 hours of pre-mission and 12

hours of post-mission crewrest which may run concurrently. Operators are subject to Duty Not Including Flying (DNIF) for physical and mental illness. Currency in several periodic refresher training areas must be maintained or operators are ineligible for flying duties. Leaves, TDYs, and miscellaneous appointments also affect an operator's availability to fly a particular mission. Schedulers must keep track of all these availability factors when completing a mission crew to prevent scheduling operators who are not available or not qualified.

Current Scheduling Procedures.

To meet the objectives of scheduling a qualified crew and providing trainees with the opportunity to become qualified, 6916ESS schedulers use a semi-structured procedure.

Projected Missions Schedule. The first step for 6916ESS schedulers in the scheduling process is to receive the monthly mission schedule from the collection management section. The projected mission schedule is received approximately one week prior to the end of the month. The schedule contains the date, mission number, mission type, expected takeoff time, expected landing time, and expected mission duration for each mission. Although the number of missions the 6916ESS is tasked to fly is somewhat static, the mission type, takeoff time, and duration change from mission to mission and season to season (i.e. aircraft can takeoff with more fuel in the winter than in the summer due to air temperatures, and thus can fly longer). Schedulers use the projected mission schedule as a guide when scheduling aircrews, however, the schedule is subject to frequent

changes. Although the number of changes vary from month to month, 6916ESS schedulers can expect an average of about 8-12 mission schedule changes per month with a lead time between receiving the schedule change and mission execution ranging from several days to 13 hours.

6916ESS schedulers begin scheduling mission crews a week to two weeks in advance. The flight which is working the day shift is responsible for manning most of the mission crew positions for normal missions. Since each flight works three day shifts before changing to swing/mid shifts, schedulers normally work on a maximum of three missions at a time.

Hard Scheduling Crewmembers. The scheduler starts with any crewmembers that must be 'hard scheduled' for a particular mission. Crewmembers who are hard scheduled include:

1) Standardization/evaluation (Stan/Eval) evaluations
2) Observers

Stan/Eval evaluation schedules are developed by the Stan/Eval section and are provided to the schedulers either verbally or via handwritten note. The Stan/Eval section provides the mission, date, evaluator's name, and evaluatee's name.

Observers are crewmembers who observe the crew for proper performance and compliance with procedures but do not have a specific function during the mission. Squadron observers include the Squadron Commander, Operations Officer, Maintenance Officer, and officer section chiefs in the Operations Branch.

Flight Commander Recommendations. After the required hard schedules are complete, the schedulers incorporate the scheduling

recommendations provided by the Flight Commander. Flight Commander's recommendations include:

1) Which trainees should fly on which missions

2) Which trainers should train the trainees

3) Which other operators should fly on which missions

Flight supervisors help their Flight Commander prepare the Flight recommendations. The schedulers will comply with the Flight Commander's recommendations as much as possible.

Airborne Mission Supervisor and Airborne Analyst. From the Flight Commander's recommendations, the schedulers turn their attention to matching operators to positions. This process normally starts with the Airborne Mission Supervisor (AMS) and Airborne Analyst positions since fewer operators are normally qualified to fly these positions than the other positions.

Trainees and Trainers. Next, the schedulers select the trainees for each mission. There are normally five to seven seats allocated to trainees. When selecting trainees, the schedulers consider the Flight Commander's recommendations, other squadron management recommendations and directives, and their own judgement. If there is a conflict, the schedulers ask the Chief of Operations Production (DOR) for resolution.

After the trainees have been scheduled, the schedulers must match a trainer to each trainee. The scheduler again considers the Flight Commander's recommendations along with other squadron management recommendations, directives, and his personal judgement. The schedulers first check the responsible flight's resources to fill the trainer requirements. If there are unfilled requirements, the schedulers consider available day

management qualified trainers. If there are still unfilled requirements, the schedulers must evaluate if the training received by the trainee is important enough to task a trainer from the swing/mid shift to fly. In this situation, the operator from the swing/mid shift will be lost to his flight for two shifts. As a result, ground processing and training will suffer on the swing/mid shift flight. As expected, this option is used very infrequently and only in extenuating circumstances.

If unfilled trainer requirements remain, the scheduler must select a different type of trainee. Once the trainee is selected, the scheduler must find a proper trainer. The same procedure described above is followed until all trainees are matched with trainers.

Completing the Rest of the Crew. The scheduler's next step is to man the remaining mission crew positions. Again, the scheduler uses the Flight Commander's recommendations as a starting point. Day management operator availability is checked to complete positions not filled by the primary (day shift) flight.

Mission Crew Changes. Even though a mission crew has been scheduled, it will constantly change before the mission is executed. Crew changes may be caused by changes in:

1) Operator availability
2) Mission type
3) Takeoff times
4) Mission priorities
5) Mission duration

6) Failed evaluations (requires remedial training flights for the trainee who failed and is a high priority)

7) Squadron management decisions

When a mission crew change is required, the scheduler must replace the operator(s). He first checks the responsible flight for available operators. If no match is made, day management operator availability is checked. If no replacement is found from the day management operators, the scheduler will schedule an operator working the swing/mid shift or who is on break as a last resort. Mission crew changes may result in other changes with that mission crew (e.g. if a trainer becomes unavailable and no other trainer is available, the trainee must be scratched and a new type of trainee and trainer found if possible). Also, changes may affect another mission crew (e.g. the only available replacement is also scheduled to fly the next day. If there is less than 12 hours for crew rest available between missions, a replacement must be found for the next days's mission).

Mission Planning Sheet and Flight Orders. The day before a mission is scheduled to fly (2 days prior for Sunday missions and 3 days prior for Monday holiday missions) the scheduler circulates the Mission Planning Sheet (MPS) to the Operations Production, Operations Training, and Standardization/Evaluation Sections and then to the Operations Officer. This is the last opportunity (in theory) for squadron management to make recommended or directed changes to a mission crew. After the MPS is signed by the Operations Officer, the scheduler makes up the flight orders. After the flight orders are finished, the only way the mission crew will normally change is due to operator

illness. As mentioned, the 6916ESS does receive last minute mission changes which could require a mission crew change. However, these type of changes are somewhat infrequent and depend on the area situation. During times of turmoil, last minute changes may occur 10-12 times a month.

Post Mission Duties. Once the mission has been completed, the scheduler must update each operator's flight card which includes updates to the 30 and 90 day flight hours.

The scheduler is also required to review the training reports written on the trainees so that he is familiar with their progress and can make proper judgements when scheduling them to fly.

Memory Aids. The schedulers have devised several manual memory aids to help them during the scheduling process. The wall outside of the scheduler's office holds the plexiglass scheduling boards. There is space for a total of 14 mission crews to be posted. For each mission, there is space for the mission date, mission number, mission type, and a block for each crewmember's name. The schedulers also have a plexiglass board to keep track of operator availability. This board is divided into areas for DNIFs, leaves, TDYs, and miscellaneous appointments.

As mentioned earlier, the schedulers maintain flight cards which contain information on each flight an operator has flown such as the date and the flight duration. The flight cards also have a running total of each operator's 30 and 90 day flight hours. The flight cards are sorted by operator type and alphabetically.

Schedulers keep an incredible amount of information concerning each operator's qualifications in their memory. To help the schedulers and other squadron personnel, the Training and Stan/Eval Sections publish a letter each month which details each operator's qualifications. Additionally, the Training Section publishes a monthly letter detailing the status of each trainee. Information in this letter includes the trainee's qualification, number of training flights received, and time remaining before an evaluation is due. Since these letters are published monthly, they become quickly outdated, forcing the scheduler to rely on his memory.

<u>Miscellaneous Functions</u>. 6916ESS schedulers must schedule other functions which impact operator availability. Each operator must complete periodic physiological, special survival, and life support refresher training to remain on flight status. Schedulers must keep track of who requires which type of training and are the focal point for scheduling operators for required training. Operators require physiological refresher training every three years. Since physiological refresher training requires a TDY to Germany and the number of openings for each refresher class is limited, schedulers must forecast physiological refresher training requirements well in advance. Special survival refresher training is required every 18 months and life support training every six months. Both types of refresher training are conducted at Hellenikon AB. Squadron schedulers maintain a list of which operators require refresher training and schedule them to attend training.

Another requirement to stay on flight status is a current

flight physical. Every operator must have a flight physical completed every year by the last day of their birth month. Physicals may be accomplished as much as two months prior to an operator's birth month. Although squadron schedulers are not required to schedule flight physicals, they are required to monitor each operator's flight physical status.

Research Problem

Aircrew scheduling is a problem area at the 6916ESS because of the dynamic environment and the number of variables involved in the aircrew scheduling decision process. Although squadron schedulers have done a good job with their manual methods, it may be beneficial to investigate computer aids for their decision processes.

Research Objectives

1) To initiate a decision aid to help 6916ESS schedulers become more efficient and produce better aircrew schedules.

2) To investigate adaptive design as a process to help build the scheduling decision aid.

Chapter II discusses past solution attempts for the aircrew scheduling problem, decision support systems in general, and the general adaptive design methodology.

II METHODOLOGY

Introduction

This chapter begins by discussing past military research solution attempts for the aircrew scheduling problem and the general inadequacies of that past research. Chapter II then discusses decision support systems in general and the adaptive design methodology used to build many decision support systems.

Past Solution Attempts

Numerous theses concerning aircrew scheduling have been written since 1980. The most flexible and dynamic effort was completed by Drowley in 1984. The Drowley thesis is a computer program which seeks to help schedulers in a USAF fighter squadron optimize resources for maximum crew training. Drowley focuses on an F-15 squadron with a single mission and one aircrew position. The foundation of Drowley's computer system is the weekly scheduling shell which includes: type of flights, takeoff and landing times, Supervisor of Flying duties, Runway Supervisor Officer duties, and Squadron Duty Officer duties.

Drowley also developed several data bases. The pilot accomplishments and flight currency data base includes information on the number of sorties pilots have accomplished and have remaining by type, the last time a pilot completed an event, and the currency requirement for each event. The pilot qualifications data base includes pilot training status, level of flight qualifications, supervisory status, and availability.

Drowley's computer program has several subprograms. The

first subprogram allows schedulers to manually input data about pilots who are not available due to DNIF, meetings, appointments, TDY, and leave. The main program uses several procedures to sort through the data base and matches pilots to missions and additional duties. One of Drowley's most important measures is a pilot's need for a particular mission. This need is calculated by dividing the number of events accomplished by the number of events required (7).

Sahli and Shacklett developed a Decision Support System for a special operations C-130 squadron. They concentrated on pilots and copilots. As with the Drowley thesis, Sahli and Shacklett manipulated data base information to develop a flight schedule. This thesis also concentrated on pilot proficiency, however, Sahli and Shacklett defined a pilot's "need" as the number of events remaining to be accomplished rather than the ratio of events accomplished to the number required (19).

Roege's thesis in 1983 concentrated on scheduling by meeting training and proficiency requirements contained in Tactical Air Command's Manual (TACM) 51-50. As with the Drowley thesis, Roege's thesis concentrated on an F-15 air-to-air squadron. Roege formulated the problem as an assignment problem. The objective was to assign pilots to duties at a specified cost subject to crew rest constraints. Roege solved the problem using integer programming. Roege used the requirements in TACM 51-50 to form an objective function. The costs were defined as the percentage of requirements completed. By minimizing this function, Roege's program schedules those pilots who are behind

in fulfilling requirements at the expense of pilots who are ahead (18).

Berman developed the Decision-Oriented Support System (DOSS). DOSS is a heuristic approach to solving scheduling problems. DOSS allows interactive computing with access to a large data base enabling the user to compare alternative schedules. Berman used payoff points, a form of weighting alternatives (19:16).

Follon improved Berman's work by developing different rules for sequencing activities. Follon's rules take the form of assigning a need indicator to each aircrew competing for a sortie. Both Berman's and Follon's systems required the use of large mainframe computers (19:17).

Pease developed the Automated Command Support (ACS.1) system. Pease developed a matrix with the days of the week as the columns and pilots as the rows. Pilot availability and a payoff were annotated in the cells. The scheduler could then quickly see which pilots should be scheduled for flights (19:19).

For their thesis, Banbridge and Cioli developed a model to analyze aircrew scheduling payoffs. This model identified aircrews which required increased or decreased sorties to meet minimum flying hour requirements. Although this thesis developed a way to identify a need, it did not address the problem of assigning preferences between aircrews for a particular sortie (19:21).

Egge addressed the deficiency of establishing preferences in the Bainbridge and Cioli thesis. Egge calculated a payoff value

using the ratio of accomplished tasks to required tasks and the time remaining to accomplish the tasks. This payoff value equated to an aircrew's need for a sortie in relation to all other aircrews (19:21).

<u>Inadequacies of Past Solution Efforts</u>. A considerable amount of research has addressed the Air Force aircrew scheduling problem. Early efforts involved attempts to apply linear programming to a static scheduling environment using mainframe computers. A special application of linear programming, the assignment problem, and integer programming have also been used in an attempt to solve the scheduling problem. These attempts have succeeded when the scheduling environment is treated as static. More recent research has addressed the scheduling problem using microcomputers. These efforts have begun to address the many variables involved in the scheduling problem and have also introduced more flexibility for the scheduler using the system. The vast majority of research thus far has been directed toward Air Force fighter squadrons with single seat aircraft and have concentrated on maintaining pilot proficiency and upgrading unqualified pilots. No research has addressed the process of scheduling multiple crewmembers for operational missions.

Past research concerning the aircrew scheduling problem has placed little emphasis on the dynamic scheduling environment. The dynamic scheduling environment requires a flexible system to provide the scheduler a choice and to take advantage of his judgment. Because of the flexibility required to be effective in a dynamic environment, a program or system which tries to

accomplish the entire scheduling process with a "one push of the button" approach, does not seem to be the answer to the total problem. Although the initial schedule might be developed using the "one push of the button" approach, the system must also provide the capability to make rapid changes easily. Therefore, a system that is flexible, adaptable, and that supports the scheduling process seems to be more appropriate.

Decision Support Systems

A promising approach to developing a scheduling decision aid is the adaptive design or prototyping process used in building Decision Support Systems. The field of Decision Support Systems is still relatively new. As such, there is no standard definition for a DSS. Alavi and Napier define a DSS as "computer based systems designed to enhance the effectiveness of decision makers in performing semi-structured tasks. With such tasks, the decision maker is uncertain about the nature of the problem/opportunity, the alternative solutions, and/or the criteria or value for making a choice. Hence, the primary role of a DSS is to aid the judgment processes as the decision maker contends with poorly defined problems" (15:21). Ford says DSSs should be designed to emphasize direct support for decision makers in order to enhance the professional judgments required in their decision making (8:21). Davis defines the purpose of a DSS as a way to couple the speed and thoroughness of automation with the insight of human experience, while adding the proper blend of quantitative support. According to Hill and Watson, "a DSS is an interactive system that provides the user with easy access to

decision models and data in order to support semi-structured and unstructured decision-making tasks" (12:82). Instead of defining what a DSS should be or do, Keen and Morton describe what a DSS should not do. That is, a DSS is "a supportive tool which does not attempt to automate the decision process, pre-define objectives, or impose solutions" (11). Sprague and Carlson prefer to define a DSS in terms of characteristics DSSs should have:

"1. They tend to be aimed at the less well structured, underspecified problems that upper-level managers typically face.

2. They attempt to combine the use of models or analytic techniques with traditional data access and retrieval functions.

3. They specifically focus on features that make them easy to use by non-computer people in an interactive mode.

4. They emphasize flexibility and adaptability to accommodate changes in the environment and decision making approach of the user" (5:6).

Keen and Morton list their characteristics of a DSS as:

"1. Assist managers in their decision processes in semi-structured tasks

2. Support, rather than replace managerial judgment

3. Improve the effectiveness of decision-making rather than its efficiency" (11)

Sprague and Carlson list both a restrictive and a broad definition in their book. Restrictively, DSSs are interactive computer-based systems that help decision makers utilize data and models to solve unstructured problems. Broadly speaking, DSSs

are any system that makes some contribution to decision making. Perhaps the best definition of a DSS as it pertains to the aircrew scheduling decision process is given by Valusek as: "a system, manual or computerized, that aids a decision maker in the cognitive processes of judgment and choice (21)."

The terms semi-structured and unstructured problems are key to several of the DSS definitions, however, rarely are these terms explained. Burleson, Kassicieh, and Lievano with the help of Simon define unstructured problems as those problems which have time constraints, a need for intuitive inputs, require a large search, or there is some uncertainty about some of the decision parameters (4:57). Meador and Rosenfeld define a semi-structured decision-making environment as an environment not well enough understood to permit a complete analytical description. This implies the need to combine managerial experience and judgment with computer based approaches (16:160).

Adaptive Design

To effectively develop a Decision Support System, a flexible approach must be taken. During the past several years research and applications in the DSS field have resulted in the development of the adaptive design approach to developing a DSS. Alavi and Napier state that generally DSS designers have recognized that the circumstances requiring a DSS call for a departure from the traditional systems development approach. This departure is caused in part by the inability of users to specify their requirements and define their decision problem (15:22). Mahmood and Medewitz believe the traditional system

development life cycle has been troublesome, complex, costly, and time consuming, especially when applied to information systems. They also lay the blame on problems in problem and requirements definition. They state: "communication between the users of the system and the systems analysts has been a particularly difficult problem, especially in the crucial stages of identifying system performance requirements. Recently, there has been increased interest in prototyping as a more efficient way of defining the system requirements and enhancing these communications links" (15:138). Mahmood and Medewitz go on to state that "the flexibility required for DSS make the traditional system development life cycle approach inappropriate and difficult. DSS require the articulation of a new design/development approach which supports the flexibility they must have" (15:138). Alavi also believes the adaptive design approach with prototyping should be used when faced with ambiguous requirements. This approach seems to be quite effective in helping decision makers define their problems and clarify fuzzy requirements. Sprague and Carlson explain their reasoning for a new development approach by stating: "Because there is no comprehensive theory of decision-making, and because of the rapidity of change in the conditions that decision makers face, the traditional approaches for analysis and design have proven inadequate...Designers literally cannot get to first base because no one, least of all the decision maker or user, can define in advance what the functional requirements of the system should be" (5:15).

The traditional systems development approach takes the form

The traditional systems development approach takes the form of four distinct steps or phases:

1. Requirements analysis
2. Design
3. Development
4. Implementation

The basic adaptive design approach is to combine the four phases of the traditional systems development approach into one single phase which is iteratively repeated in relatively short cycles (5:137-139). Most definitions of adapative design are variations from this theme. Courbon's Evolutive Design is very similiar to adaptive design as described by Mahmood and Medewitz. Evolutive Design is "a methodology based on progressive design of a DSS, going through multiple as-short-as-possible cycles, in which successive versions of the system under consideration are utilized by the end-user" (15:140). The four steps of the Evolutive Design methodology are:

1. Identify an important sub-problem. The objective of this step is to provide some immediate relief to the problem which will hopefully help establish the decision makers confidence in the system and to set up a good working relationship between the designer and the decision maker. This important sub-problem is also called the "kernel."

2. Quickly develop a small but usable system to assist the decision maker. The objective of this step is to provide a system the user can employ quickly. The system may not have elaborate capabilities, but will help during the decision-making process. The designer and the user do not neglect the

traditional systems development approach, but they do try to minimize the time required to go through these stages.

3. Refine, expand, and modify the system. During this step, the designer or builder modifies the system as a result of inputs from the user.

4. Evaluate the system constantly. This is the control mechanism for the evolutive method. If the DSS does not meet the user's needs, renewed efforts are made to improve the system (15:141).

The steps in Sprague and Carlson's adaptive design method are similiar to Courbon's:

1. User and builder agree on a small but significant sub-problem;

2. Design and develop an initial system to support the decision-making that it requires;

3. After a short period of use (a few weeks), this system is evaluated, modified, and incrementally expanded;

4. This cycle is repeated three to six times over the course of a few months until a relatively stable system evolves (5:140).

When this general methodology is applied in designing a specific DSS, the following steps should be followed:

1. Version 0 -- an initial usable system. The starting system should support a small problem or a small part of a bigger problem.

2. The system is modified through successive cycles and versions 1 through S.

3. Version S is a relatively satisfactory version which then becomes somewhat stable. The frequency of modification and incremental change cycles will decrease but will not stop (5:141).

Belardo provides a graphical representation of this process in Figure 2.1 (3:96).

Keen provides a structure for the DSS adaptive design methodology consisting of the user, builder, and the technical system (DSS). Specifically, the interfaces between these three components provide the framework within which the rapid cycles may take place. The user - system interface concerns the effect a user's characteristics have on system utilization. As a result of interaction with the system, the user's understanding

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                                             \
 -----------------                            \  -----------------
:                 : ______________________     \:     DEVELOP     :
:    IDENTIFY     : BASIC                      /     VERSION 0    :
:_________________:      REQUIREMENTS         / :    PROTOTYPE    :
                                                :_________________:
                                                         :
                                           2ND STAGE     :
                  --------------                         :
                 : DEVELOP      :  /    REQUIREMENTS     :
          _____  : VERSION 1    / _______________________:
         :       : PROTOTYPE    \        CONCENSUS
 VERSION 1       :______________:  \
 WORKING :
 PROTOTYPE
         :
         :
      \  :  /
 ______\ /______                          \  ---------------
:               : ________________________ \:               :
:   IMPLEMENT   : PROBLEMS & MISFITS       /     REVISE     :
:      AND      : /                       / :     AND       :
:      USE      / ______________________:     ENHANCE       :
:               \   NEXT VERSION          :                 :
:_______________:  \                       :_______________:
```

Figure 2.1 Adaptive Design Process

of the decision process and potential solutions increases. The builder - system interface occurs as the builder adds and modifies capabilities and functions to the system. The user - builder interface involves healthy communication and cooperation during the development process. As a matter of fact good communications between the user and the builder is the key to successful DSS development (5:21).

Sprague and Carlson list several mechanisms which aid the adaptive design method:

1. Definition of roles -- definition of who the user, builder, and technical support people are

2. The technology -- the need to build a small usable system and change it constantly places difficult demands on technology. Advances in technology, specifically in the area of DSS generators have made the iterative nature of adaptive design feasible.

3. Communication mechanisms -- because of the compressed sequence of steps and rapid cycling of adaptive design, communications between the user and the builder are very important. A system developed to provide documentation of user requested or desired changes is essential if the system is to develop to its potential.

4. Documentation capability -- a dynamic documentation capability is required. Since the DSS will evolve quickly with new capabilities being added constantly, a system journal or diary is required to document the current system configuration. This journal is also a good source of past attempts in developing system capabilities.

5. Evaluation and tracking -- in order to determine if the DSS is effective, proper evaluation criteria must be developed for the DSS (5:142-144).

ROMC

One of the primary reasons the adaptive design methodology was developed is the inability of users to define their decision processes and requirements. Decision makers have a difficult time describing their decision processes. However, they do seem to rely on conceptualizations (e.g. like pictures, graphs, and charts) when making or explaining a decision (5:98). An effective method of helping the user to define his requirements is with the use of the Representation, Operation, Memory aids, and Control mechanisms (ROMC) method (5:100). The objective of the ROMC approach is to help reduce the differences between the requirements of decision-making and decision makers, and the capabilities of the DSS. ROMC is especially useful in situations where a decision maker cannot specify, or can only partially specify, the requirements of a decision in advance (5:116). Sprague and Carlson define the ROMC method as a decision process independent approach for identifying the necessary capabilities of a specific DSS. ROMC is a tool to focus the system builder before the actual design of the DSS (5:100-107).

The framework for the ROMC approach, as one might suspect, is contained in the representations, operations, memory aids, and control mechanisms decision makers identify as being associated with their decision process.

REPRESENTATIONS: Provide the context in which decision

makers can interpret outputs and invoke operations. The representations are developed in terms of Simon's Intelligence, Design, and Choice decision activities and can be used as a vehicle to conceptualize and communicate the decision situation.

OPERATIONS: Provide an opportunity to analyze and manipulate the representations. This process can also be used to identify operations the decision maker would like to see integrated into the DSS. Besides basic manipulations of the representations, operations can also take the form of more complex functions or models like forecasting, simulation, linear programming, etc. Identifying the intelligence, design, and choice activities associated with the decision process is a useful way of developing operations. Typical intelligence, design, and choice activities are listed in Table 2.1.

MEMORY AIDS: Employ representations and operations to support the use of operations and representations. Memory aids may take the form of workspaces, notepads, data bases, default profiles, etc.

CONTROL AIDS: Formalizes a decision process using representations, operations, and memory aids. Control aids are intended to help a decision maker use the representations, operations, and memory aids during the decision process. They may take the form of the user - system interface, user manuals, training manuals, menus, function keys, error messages, help commands, and procedure construction capabilities to combine multiple operations on one or more representations or to develop new operations (5:102-107).

Table 2.1 Intelligence, Design, and Choice Activities

INTELLIGENCE	DESIGN	CHOICE
Gather data	Gather data	Generate statistics/ alternatives
Identify objectives	Manipulate data	Simulate results of alternatives
Diagnose problem	Quantify objectives	Explain alternatives
Validate data	Generate reports	Choose among
alternatives		
Structure the problem	Generate alternatives Assign risks/values to alternatives	Explain the choice

Taken from Sprague and Carlson p. 104

<u>Evaluation</u>

The whole principle behind the adaptive design approach is to continually modify the system to meet the user's needs. In order to more effectively define where the DSS is and is not meeting the user's needs, the DSS must be constantly evaluated. If the DSS is not evaluated during the design and implementation, it may not be done at all or it will just be a confirmation that the system either does or does not aid the decision maker (5:158).

The evaluation of DSS success or effectiveness is a complicated and difficult task because of the difficulty in quantifying how much the DSS helps the decision maker. The most commonly used indicators of success for computer based information systems are system usage and user attitudes and perceptions. The most commonly used measure of success is the user's satisfaction with the capability of their system in fulfilling their requirements. User satisfaction is also used as

a measure of system effectiveness since greater usage is associated with greater perceived effectiveness (15:145,13:83-86). Since user satisfaction only indicates perceived effectiveness, Sprague and Carlson have developed more detailed evaluation criteria for DSS.

Sprague and Carlson group DSS evaluation criteria in four areas:

1. Productivity Measures: Measure of the impact the DSS has on decisions. Examples of productivity measures include the time required to reach a decision, the cost of making a decision, and the cost of implementing a decision.

2. Process Measures: Measure of the impact the DSS has on the decision process. These measures include the number of alternatives examined, the amount of data used, the time spent in each phase of decision making, and the number of participants in the decision process.

3. Perception Measures: Measure of the impact the DSS has on the decision maker. Perception measures include the control of the decision-making process, ease of use, usefulness of the DSS, and the decision makers conviction that the decision is correct.

4. Product Measures: Measure of the technical merits of the DSS. Product measures include the system response time, system availability, operating costs, education/training costs, and data acquisition costs (5:158-160).

DSS Structure

To provide the necessary flexibility and adaptability

necessary for the development of a DSS using the adaptive design methodology, a modular design is required. Sprague and Carlson provide such a framework with their dialog component, data component, and model component structure.

Dialog Component. However the DSS is used, the user must communicate with the computer via some type of dialog. The dialog component is comprised of the hardware and software that provide the interface between the user and the DSS. The user - system interaction implies three necessary capabilities. First, the interaction must have an action language. The action language defines what the user can do to communicate with the system. The action language may be made up of inputs from regular keyboard, function keys, touch panels, a joy stick, a mouse, or voice commands. Second, the user - system interaction involves a display or presentation language. The display language provides what the user actually sees and may include character or line printers, a display screen, a graphics capability, a color monitor, plotters, or a voice output. Third, the interaction requires a knowledge base which includes what the user must know to interact with the DSS. The knowledge base may be in the user's head, in a reference manual, or provided through help commands. Combinations of these three interaction capabilities comprise the dialog between the user and the DSS (5:198).

The manner in which the interaction capabilities are combined produces the dialog style. The effectiveness of a particular style depends on the type of user, the task to

perform, and the general decision situation. Following are descriptions of several types of dialog styles:

1. Question/Answer Dialogs: This style consists of a question and answer session between the user and the system. It allows the system to lead the user through the decision process in a rather structured manner. The question/answer dialog style seems to be most effective when dealing with inexperienced or infrequent users who are unfamiliar with the problem to be solved. This style is least successful for the sophisticated or frequent users (5:199).

2. Command Language Dialog: The command language dialog style consists of a formal language. This style has the advantage of being relatively quick, however, the casual user will probably have to relearn the language each time he uses the system (5:200).

3. Menu Dialogs: This style allows the user to proceed along a course of menus as he proceeds through the decision process. The menu dialog style offers the advantages of the question/answer dialog style, however, it still allows some flexibility to investigate the problem as the user sees fit. The menu dialog has become a very popular style for DSSs (5:201;2;3;4).

4. Input Form/Output Form Dialog: This type of dialog is very useful for entering, displaying, and modifying data base information (5:202).

5. Combination Dialog: As its name implies, the combination dialog contains combinations of several different dialog styles. The use of the combination dialog allows the DSS

to remain flexible and effective for both experienced and inexperienced users (5:203).

Data Component. The data component supports the memory requirements of the DSS. The data component encompasses many of the intelligence activities from Simon's model. The data component must meet many different requirements. Although the requirements for every specific DSS will be different, the following list of data component requirements should be considered:

1. Support for memory aids such as workspaces, intermediate results, notepads, memory joggers, etc.

2. Data reduction: This includes subsetting, combining, and aggregating.

3. Support varying levels of data detail.

4. Support varying amounts of data.

5. Support multiple sources of data: data external to the organization, internal data, and data from different parts of the organization.

6. Support a catalog of data sources: This provides the user with the ability to see where data comes from and what data is in what data base.

7. Support a wide time frame of data: Some decisions require data projected to the future in addition to historical data.

8. Support data security: Some data may not be appropriate for the entire organization to access.

9. Performance: The response time between a data

query from the user and fulfillment of the request must be quick enough that it does not interrupt the users decision process.

10. Interface to the other components: The data component must interface smoothly with the other two components for a DSS to be effective (5:240;21).

The heart of the data component is the data base management system (DBMS). "A DBMS is a collection of computer programs used to create, maintain, access, update, and protect one or more data bases" (5:222). Operations provided by a DBMS include (5:240):

1. Create
2. Delete
3. Dictionary
4. Update
5. Query/retrieval
6. Views/subsetting
7. Protection/security
8. Sharing
9. Recovery
10. Optimization

There are several different approaches in implementing a DBMS. Among the most popular today is the relational data base approach. The relational approach is relatively easy to understand and provides set operations, independence of data programs, operation and integrity constraints, and a close coupling between the data base and the data dictionary (5:226).

<u>Model Component</u>. The modeling component supports Simon's design and choice activities. The model component contains the operations that manipulate the representations. As stated

previously, these operations may be as simple as a set of command language statements that can be sequenced to sophisticated forecasting and linear programming models. The model component allows the user to analyze the problem and create alternative solutions. Sprague and Carlson feel the integration of models into an information system moves it from being a management information system to a decision support system (5:259).

General design and choice activities the model component may support are: projection, deduction, analysis, creation of alternatives or suggestions, comparison of alternatives, optimization, and simulation. The model component should allow examination of intermediate results and accommodation of subjective judgment during the problems solving process (5:260).

DSS Generator

Flexible software is required to implement the DSS component modules and to support the continuous system changes required in adaptive design methodology. Kaul and Saxena have expanded Sprague and Carlson's suggestions for a DSS generator structure.

Kaul and Saxena list 5 essential components of a general DSS generator:

1. User Interface Manager
2. Representation Manager
3. Analysis Manager
4. Systems Manager
5. Data Extraction Manager

Although all these components may not be required to build a specific DSS, they do provide the general capabilities required

of a DSS generator (10:150).

User Interface Manager. The User Interface Manager provides the software support to develop a variety of dialog styles. The term "User Friendliness" has often been used to describe a required user - system interface. Unfortunately, what is user friendly for one decision maker may not be user friendly to another. Kaul and Saxena believe the dialog style used to achieve user friendliness is a function of training or experience and how much the decision maker uses the system. As can be seen from Table 2.2, to achieve maximum system flexibility the User Interface Manager should have the capability to develop three basic dialog types. Additionally, the User Interface Manager should have the capability to address alpha-numeric and graphics displays, printers, and plotters (10:150).

Table 2.2 Dialog Styles

	Casual User	Regular User
Trained User	Menu Command Language	Command Language
Untrained User	Natural Language/ Question & Answer	Menu

Representation Manager. The Representation Manager supports the representations function in the ROMC requirements definition approach. The Representation Manager should provide the capability to develop and save a variety of different screen

displays such as pie charts, bar graphs, spreadsheets, data base entry forms, and data base reports. The Representation Manager should also have the capability to store and retrieve command sequences to produce a particular screen representation or printed report (10:151-152).

Analysis Manager. The Model Manager is primarily concerned with supporting the model component of the DSS. The Model Manager should have the capability to develop mathamatical modeling and command procedures. A model base management capability is also highly desirable. Model base management is a flexible way to define, save, invoke, and delete analyis routines similiar to the relationship between a data base management system and the data base. An additional requirement of the Analysis Manager is data manipulation (10:153-154).

System Manager. The System Manager provides support to the more DSS-unique and advanced requirements. The System Manager should provide the capability to accomodate decisions made by groups or decisions made in parts by several different individuals which require shared data and model bases. The System Manager also supports the control mechanism portion of ROMC by providing a capability to define function and control keys and develop help facilities. The more advanced capabilities of the System Manager include providing feedback to both the DSS user and builder. This feedback may be in the form of recording the frequency of command usage, response times to operations, data base capacity, and user errors. Finally, the System Manager should be able to record system problems and desired changes

(10:155-156).

Data Extraction Manager. The data extraction manager is concerned with the capability of the system to access required external data bases and extract the required data (10:157).

Expert Systems

Expert Systems (ES) are in many ways similiar to Decision Support Systems (DSS). Both ES and DSS are developed to improve decision-making, however, there are also significant differences between the two. In a way, DSSs are broader than ES. As such, ES can be integrated into an overall DSS -- possibly as part of the model component.

An Expert System is "a problem solving program that achieves good performance in a specialized domain that generally requires specialized knowledge and skill. The systems process the knowledge of experts and attempt to mimic their thinking, skill, and intuition" (8:22). Expert Systems generally have three basic characteristics:

1. The areas of knowledge have 4 prerequisite qualities:

a. They have a well-defined domain of application and are sufficiently constrained to make successful coding of relevant knowledge likely.

b. There is at least one expert who can perform the task well.

c. The expert is available to help develop the knowledge base which contains special knowledge, judgment, and experience factors.

d. The expert can clearly describe the knowledge base and explain the methods of applying it to the task.

2. ES employ a significant amount of heuristic problem solving or rule of thumb techniques.

3. ES use three different general kinds of information:

a. Task Specific: data relevant to the current ES analysis.

b. Domain Specific: the knowledge base as described above and including problem solving rules.

c. Control: the inference engine which applies axiomatic knowledge in the knowledge base to the task specific data in order to arrive at possible solutions (8:23-25).

In addition to those characteristics listed many ES are now being developed with an explanation capability. This capability provides the logic used to arrive at a solution (8:24;17).

Expert Systems and Decision Support Systems can be compared in several different areas. As mentioned above the basic goal of both systems is to improve the quality of decisions the systems support. Although the basic goals of the two systems are the same, they have different objectives. Generally, the objective of a DSS is to provide the decision maker with a data and model capability to be used as the decision maker desires during the decision process. The general objective of an ES is to provide the decision maker a conclusion or decision that is correct a high percentage of the time. The differences in objectives leads to differences in the operational utilization of the two systems. A DSS allows the user to confront a problem in a flexible way by

providing the ability to manipulate data and models in a variety of ways while progressing through the decision process. As such a DSS user exercises direct control over the various DSS components. With an ES, the user retains little if any flexibility in the way the system analyzes the problem. In other words the system directs the user. Both systems are designed using an adaptive design type of approach but for different reasons. DSS builders generally use the adaptive design approach to allow greater user involvement in the design process, allow the system to evolve and adapt to the needs of the user, and to provide usable decision support in the early stages. ES developers use adaptive design to allow the knowledge base to be refined or expanded. Since the performance of an ES is primarily dependent on the completeness and quality of the knowledge base rather than the reasoning techniques, the system must be built up adaptively or in stages before complex problems can be solved (8:22-26;17;21).

Chapter III discusses the application of the adaptive design methodology to the problem of building a decision aid for the 6916ESS scheduling problem. Chapter IV discusses the system that resulted from applying the adaptive design methodology.

III APPLICATION OF ADAPTIVE DESIGN TO THE 6916ESS SCHEDULING DECISION AID

Introduction

Chapter 3 discusses the application of the adaptive design methodology to the problem of building a decision aid for the 6916ESS. The first action in the adaptive design process was to select a decision process within the 6916ESS which could benefit from a computer-based decision aid. Several areas within the squadron were good candidates. However, the operations aircrew scheduling process was chosen. From experience, the scheduling decision process offered the greatest potential for increased efficiency and effectiveness by saving time and reducing scheduler mistakes.

When developing a DSS, the builder will normally begin by trying to define the decision process. This action was not necessary in this case because the 6916ESS' scheduling process is already well defined and well understood. Although defining the actual decision process was not necessary, important functions or activities within the decision process had to be identified.

Structuring the Decision Process

Identification of the major functions and activities within the scheduling process was the first step in structuring the decision process. The major scheduling functions and activities were identified from experience and through correspondence with the 6916ESS schedulers. Once the functions and activities were identified, they were grouped in common areas and displayed a

line diagram format similiar to an organization chart. Figure 3.1 shows the organization chart for the major scheduling functions and activities.

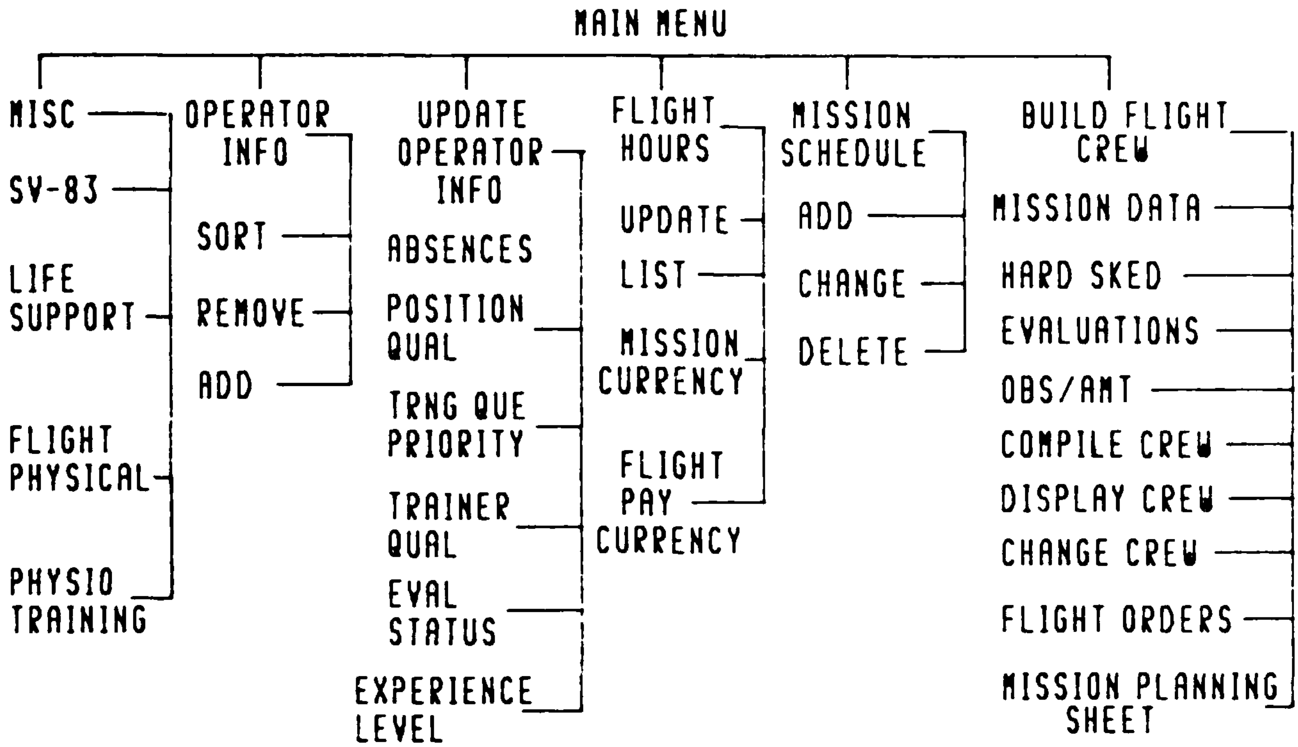


Figure 3.1 Main Menu

The Storyboarding Process

The next step in the adaptive design process was to develop storyboards for each function and activity identified in the feature chart. As discussed in Chapter II, Sprague and Carlson's Representations, Operations, Memory Aids, and Control mechanisms (ROMC) are an effective approach in developing storyboards. Using the ROMC approach, example computer screens were developed to portray what the scheduler would like to see on the computer screen and have available to him when performing the major

scheduling functions and activities. The storyboarding process started by developing example menu selection screens. The connectivity for the menu structure was taken directly from the organization chart. After the general organization menus were completed, sample computer screen "snapshots" were developed for the specific functions and activities. For each storyboard, the representations, operations, memory aids, and control aids to assist the scheduler while performing an activity were listed for each sample computer display. Since one of the major tenants of adaptive design is to involve the user as much as possible, a copy of the storyboards were sent to the 6916ESS schedulers for their comments and recommendations. Due to the distance between the builder and the 6916ESS, the US mail system provided the only option for connectivity. The effectiveness of accomplishing portions of the adaptive design process remotely is discussed in Chapter V. Storyboard examples developed for the 6916ESS scheduling decision process can be found in Appendix A.

Results of the Storyboarding Process. The storyboarding process was an invaluable exercise in building the 6916ESS scheduling decision aid. Storyboarding helped to further identify and refine the major scheduling functions and activities. Use of the ROMC approach and associated identification of individual representations and operations associated with each activity, permitted a more detailed investigation of the scheduling process. Specifically, the storyboards provided a clearer view of the interrelationships

between different scheduling activities. Identification of the memory aids that would be needed for each activity was a major factor in developing the data base requirements. Memory aids also established a requirement for a capability to allow the scheduler to make notes to himself while performing scheduling activities. Identification of the representations, operations, and control aids necessary for each activity also helped define the dialog style best suited for the scheduling decision aid. Finally, and maybe most importantly, the storyboarding process permitted a detailed examination of the functional requirements for the scheduling decision aid. In other words, the storyboarding process identified what outputs the resulting system should contain and what functions were necessary to support the major scheduling decision process at the 6916ESS. A total of approximately 30 hours were spent building this initial system design.

Since the storyboarding process helped identify the major system requirements, the next step was to begin implementing on the computer those functions and activities identified through the storyboarding process on the computer. However, before the system could be built, a software package supporting the major elements of the decision aid design process had to be selected.

Software Selection

Software selection was driven by what was available for the Zenith Personal Computers at AFIT and what could reasonably be expected to be available at the Air Force squadron level. These constraints narrowed software selection to dBASE III, Lotus

1-2-3, and Enable. dBASE III is primarily a relational data base system with the ability to develop user defined menus. Since it is primarily a data base system it does not offer the flexibility required to build an entire decision aid or decision support system, however, it could function as the data base component. Similarly, Lotus 1-2-3 is primarily a spreadsheet system. It could function as the prime system for the model base component. Enable is an integrated wordprocessing, spreadsheet, and relational data base management system. Enable offers the flexibility needed to construct a decision aid and since it is a versatile package, problems associated with integrating a separate spreadsheet, data base management system, and wordprocessing capability are minimized.

When Enable was compared with the DSS generator requirements listed in Chapter II, it did quite well. Enable provides the capability to develop different dialog styles including application specific menus, system menus, question and answer, and a command language. Enable has a graphics capability to develop pie charts, bar charts, and line graphs. The spreadsheet application displays a spreadsheet similiar to Lotus 1-2-3 that can be sized to meet the user's needs. The data base management system application allows the user to develop user defined input and output forms or to take advantage of the standard system forms. Additionally, Enable allows the user to have up to eight applications or windows open simultaneously (e.g. 4 spreadsheets, 2 data bases, and 2 word processing files) and also permits the user to size each window individually. The macro coding procedure allows the user to develop sophisticated

models within the spreadsheet application. Enable has an extensive help facility which can be supplemented by user defined help files. It also allows the user to define function keys and other alpha-numeric keys to perform different functions. Enable does not support some of the more sophisticated DSS generator features such as recording the frequency of command usage or capturing response times to operations, and user errors, but these features were not essential because the 6916ESS scheduling problem is relatively well defined and each function built for the system is important to the scheduling function. The more sophisticated DSS generator features would be more important for a DSS being built for a relatively undefined decision process where the builder was not certain what functions would be the most important or that received the most use.

Enable is a flexible software package and meets most of the DSS generator requirements required to build the 6916ESS decision aid. Additionally, Enable is available at AFIT. Finally, since Enable is provided with the Air Force Zenith Z-248 buy, it can reasonably be expected to be provided at the squadron level. After the software package was selected, system implementation began.

Kernel Selection

Since there were many functions and activities to implement, where should the builder start? The subproblem selected as the starting point is referred to as the kernel. Woolsey suggests the builder should choose those functions which are the most time consuming and mundane as the starting point for implementing a

DSS (22). If the DSS saves the user time, he will have more time to spend on the more difficult activities which require his judgment and choice. This approach seemed well suited to the 6916ESS scheduling problems since one of the objectives of the scheduling decision aid is to save the scheduler time.

Two activities were identified which fit Woolsey's criteria of time consuming and mundane. First, the name, rank and social security number of each mission crewmember must be typed on the flight order forms. Since the 6916ESS schedulers were still doing this with a typewriter, it takes them up to 45 minutes to type the flight orders with no mistakes. Second as mentioned in Chapter I, schedulers must keep a running total of each operator's 30 and 90 day flight hour totals. Calculation of flight hours may take a scheduler over one hour after mission completion. Since these two activities are time consuming and take the schedulers attention away from their primary purpose of scheduling operators to fly, they were selected as the place to start system implementation.

Implementation of the Kernels

In order to implement the two kernel activities, experience with the Enable software package was required. Both kernels required the use of several Enable applications (i.e. wordprocessing, spreadsheet, and data base). The two kernels were implemented using the storyboard representations of these two activities and through experimentation with the different Enable applications and interfacing between applications. The end

result of implementing the two kernel activities was Version 0 of the 6916ESS scheduling decision aid.

Data Base Definition

As mentioned earlier, the storyboarding process helped identify the data that was required to perform the various scheduling functions and activities. The specific data base requirements were organized into data relations. Additionally, the relationships between different data relations were also defined. Since the data base is perhaps the most important component of the scheduling decision aid, proper data base definitions were very important. Due to the importance of the data base, assistance from a data base expert was requested to efficiently define the data structures. Inefficient data base design produces unnecessary duplication of data and inefficiencies in data retrival. As a result, system response time suffers and computer disc storage space becomes constrained.

To develop most of the scheduling functions and activities, example data was required. As a result, sample data was put into the data base. The validity of the data is based on experience and the percentages of the different type of operators and their qualifications as presented in chapter I.

System Expansion

After the kernel activities were implemented, the system was expanded one function at a time starting with the process of building the mission flight crew and ending with the activities not directly associated with scheduling operators to fly a

particular mission. After each function and activity was implemented it was tested under a variety of conditions to insure proper output. The test conditions were developed in advance of testing and were designed to portray a typical mission crew. When problems were identified, they were fixed when possible before starting the next activity. The system expansion process resulted in Version 1 the of 6916ESS scheduling decision aid. Version 1 will be discussed in detail in Chapter IV.

System Evaluation

When Version 1 was nearing completion, the system was evaluated by a pseudo-scheduling expert from HQ ESC. Since it was not practical to get a scheduler from the 6916ESS to come and evaluate the decision aid, a former Operation Superintendent at the 6916ESS evaluated the decision aid. Suggestions made by the evaluator were implemented where possible.

Future System Modifications

Throughout the entire system design and implementation process, capabilities which were not implemented in Version 0 or Version 1 were documented for future implementation. These additional capabilities will be discussed in Chapter V.

Chapter IV discusses the decision aid resulting from the adaptive design process. The resulting system will be described in terms of Sprague and Carlson's DSS structure (i.e. dialog, data base, and model base) and the decision aid's menu structure.

IV 6916ESS SCHEDULING DECISION AID

Introduction

This chapter discusses the system resulting from the design process discussed in Chapter III. The organization and structure of the decision aid which evolved from the storyboarding process closely parallels the original feature chart and the storyboards. Although the organization of the scheduling functions and activities changed slightly, the actual functions and activities remained basically the same. The organization of the 6916ESS scheduling decision aid is structured through the use of a multi-level menu system, with the main menu defining the major functions of the system. Additionally, extensive use was made of Enable's windowing capability to provide several different pieces of information to the scheduler simultaneously. Before providing a general description of the decision aid's functions, the decision aid's components (dialogue, model base, and data base) are discussed. The actual computer code (macros) developed for the system serves as a program maintenance manual and is located in Appendix C. A User's Guide is located in Appendix B.

System Components

As presented in Chapter II, the three components of a Decision Support System as described by Sprague and Carlson are the dialog, model base, and the data base. These components provide the overall structure for the 6916ESS aircrew scheduling decision aid.

Data Base Component. The data base component is perhaps the most important component in the scheduling decision aid because the 6916ESS aircrew scheduling process is data intensive. The data base is composed of six data relations shown below in Figure 4.1.

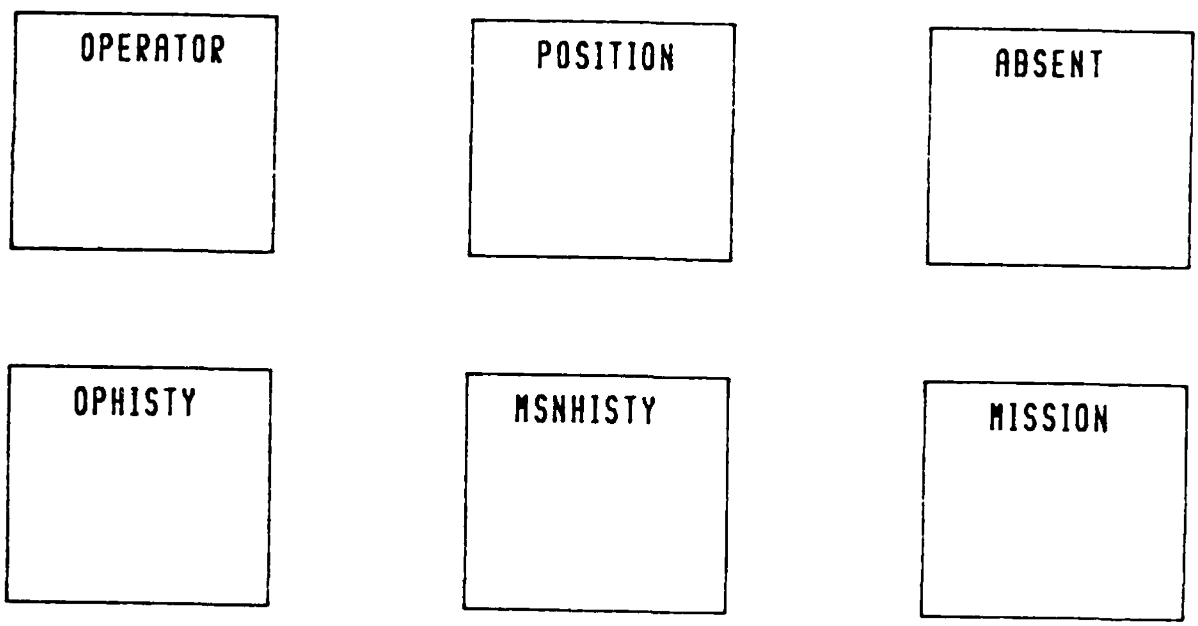


Figure 4.1 Data Base Relations

OPERATOR. The OPERATOR relation contains general information about each operator as described in Table 4.1.

Table 4.1 OPERATOR.DBF Relation

FIELD NAME	DESCRIPTION	PURPOSE
SSAN	Operator's Social Security Number	Used as a unique identification number which allows integration of several relations
LASTNAME	Operator's Last Name	Used by the scheduler as the primary means of identifying an operator
FIRSTNAME	Operator's First Name	Used in conjunction with an operator's last name
MI	Operator's Middle Initial	Used in conjunction with first and last names
RANK	Operator's Rank	Used for Flight Orders and crew balance
TYPE	Operator's General Type	Used for general data base searches for squadron management
CREW	Operator's Work Crew (Able, Baker, Charlie, Days)	Used for data base searches to identify operators for a mission
THIRTY	Number of Flight Hours an Operator has over the past 30 days	Used to insure an operadoes not exceed AF limits for 30 day hours
NINETY	Number of Flight Hours an Operator has over the past 90 days	Same as THIRTY except for 90 consecutive days instead of 30
SV83	Date Operator last attended SV-83 training	Used to schedule operators for SV-83 training
LIFESPT	Date Operator last attended Life Support Training	Used to schedule operators for semi-annual life support training
PHYSIO	Date Operator last attended Physiological Training	Used to schedule operators for recurring physiological training
FLTPHYS	Date Operator last had a Flight Physical	Used to monitor compliwith annual flight physical requirement

The information contained in the OPERATOR relation is used by several other relations as shown in Figure 4.2.

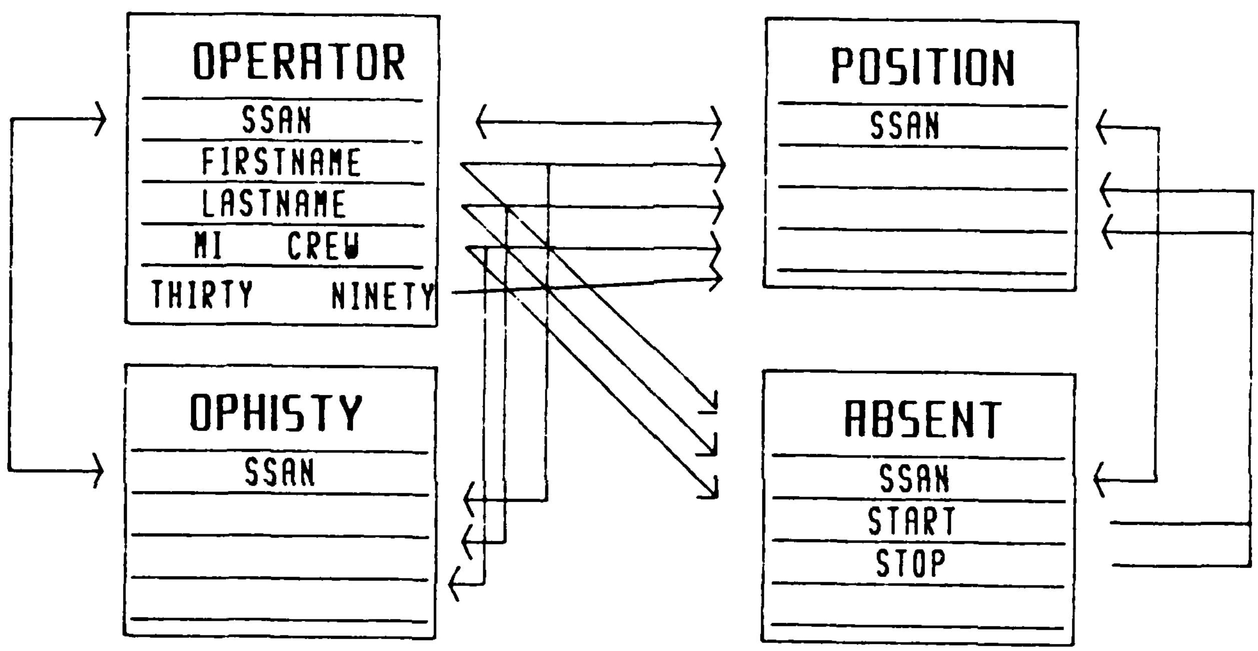


Figure 4.2 Relation Integration

POSITION. The POSITION relation is the primary relation used for data base searches. This relation contains information concerning the position qualifications each operator possesses. Specific fields are described in Table 4.2.

Table 4.2 POSITION.DBF Relation

Field Name	Description	Purpose
SSAN	Operator's Social Security Number	Unique identifier which allows access to other relations
POSITION	Position Designation	Desgnation for each position an op is qualified for or is in training for
PRIMARY	Yes/No field	Flag for an op's primary position
QUAL	Position Qualification Level	Designator for the qualification level an op has reached for a position
TRAINER	Yes/No field	Flag to designate if an op is a qualified trainer
EVAL	Evaluation Date	Date an op is due an evaluation for a position
EXPLEVEL	Experience Designation	Subjective measurement of an op's experience in a position -- Assigned by squadron management -- Defined for future model applications
TRNGQUE	Training Priority	Subjective priority given to trainees -- Assigned by squadron management.
STRENGTH	Strength as a Trainer	Used to help match trainees with trainers
WEAKNESS	Weakness as a Trainee	Used to help match trainees with trainers

The following fields access information from the OPERATOR relation: (see Table 4.1)

LASTNAME, FIRSTNAME, MI, RANK, CREW, THIRTY, AND, NINETY

The following fields access information from the ABSENT relation: (see Table 4.3)

START, STOP, AND REASON

The POSITION relation draws upon the OPERATOR relation for an operator's name, crew, rank, and 30 and 90 day flight hours. This relation also draws upon the ABSENT relation for operator availability data. The POSITION, OPERATOR, and ABSENT relations are interfaced with each other through the use of the operator's social security number as shown in Figure 4.2.

__ABSENT__. The ABSENT relation contains information concerning an operator's availability to fly. Specific fields are described in Table 4.3.

Table 4.3 ABSENT.DBF Relation

Field Name	Description	Purpose
SSAN	Operator's Social Number	Allows scheduler to link to other data relations
START	Date Operator becomes Unavailable	Used during searches for available operators
STOP	Date Operator becomes Available	Used during searches for available operators
REASON	Reason Operator is Unavailable	Used to answer queries why an operator is unavailable

The following field names access data from the OPERATOR relation: (see Table 4.1)

LASTNAME, FIRSTNAME

__OPHISTY__. The OPHISTY relation contains each operator's flight history, similiar to the flight cards currently manually maintained by the schedulers. Specific fields for this relation are described in Table 4.4.

Table 4.4 OPHISTY.DBF Relation

Field Name	Description	Purpose
SSAN	Operator's Social Security Number	Used to access information from other data relations
MISSION	Mission Number Designation	Used to access information from another relation
DURATION	Mission Duration in hours	Used to calculate 30/90 day flight hours
POSITION	Position Designator	Used to designate which position op flew
DATE	Mission Date	Used to when calculating 30/90 day flight hours

The following field names access information from the OPERATOR relation: (see Table 4.1)

LASTNAME, FIRSTNAME

__MSNHISTY__. The MSNHISTY relation contains the general mission history for the squadron. Specific fields for this relation are described in Table 4.5.

The MSNHISTY data relation is not critical to the scheduling decision aid. However, it will be very important if the decision aid is expanded to include other squadron decision processes such as collection management. Further discussion of system expansion is given in Chapter V.

__MISSION__. The MISSION relation contains information on the projected mission. Specific fields are described in Figure 4.6.

Table 4.5 MSNHISTY.DBF Relation

Field Name	Description	Purpose
MISSION	Mission Number Designator	Unique identifier for each mission
DATE	Mission Date	Date mission was flown
TAKEOFF	Take Off Time	Take off time helps determine mission duration
LAND	Land Time	Land time helps determine mission duration
DURATION	Mission Duration	Used when determining total hours flown by the squadron
ORBITTIME	Mission Orbit Time	Total time on orbit helps determine mission effectiveness
WATCHTIME	Mission Watch Time	Total watch time helps determine mission effectiveness
STATUS	Mission Status	Determined by planned vs actual orbit time -- a measure of effectiveness
REMARKS	Mission Remarks	Used to add general remarks about a mission
PRIORITY	Mission Priority	Used to highlight missions that required special attention when scheduling the mission crew

Table 4.6 MISSION.DBF Relation

Field Name	Description	Purpose
TYPE	Mission Type	Determines position configuration
NUMBER	Mission Number	Unique identification for each mission
TAKEOFF	Take Off Time	Scheduled takeoff time helps determine crewrest violations
LAND	Land Time	Scheduled land time helps determine crewrest violations
DATE	Mission Date	Scheduled mission date determines which crew is responsible for mission manning
SHOWTIME	Pre-mission Show Time	Scheduled crew showtime determined by scheduled takeoff time
PRIORITY	Mission Priority	Designator for missions that require special attention when scheduling crewmembers
DURATION	Mission Duration	Scheduled mission duration determined by scheduled takeoff and land times

Dialog Component. The dialog component of the 6916ESS aircrew scheduling decision aid is composed of several different dialog types. System unique menus assist the user in moving from one scheduling function to another and also within a specific function. A question and answer dialog style is used when the system needs information in order to carry out an operation. One-stroke function keys are defined to allow the user to quickly

and easily accomplish repetitive operations. Finally, the user can also use the generic Enable menu system for general operations like browsing through the data base.

Model Base Component. The model base does not contain any sophisticated analytical techniques. Instead, the model base contains the macro codes necessary to allow the system to model the 6916ESS aircrew scheduling decision process as much as possible. Traditional analytical techniques and other models could be integrated into the 6916ESS aircrew scheduling decision aid and could probably benefit the 6916ESS schedulers. Further discussion on this subject is contained in Chapter V.

Main Menu

The main menu developed for the 6916ESS scheduling decision aid is depicted in Figure 4.3. The main menu is automatically displayed for the user after the system logo. The main menu provides the scheduler a choice of the main functions he is responsible for. The remainder of this chapter will be devoted to providing a general description of the major scheduling functions implemented in the kernel 6916ESS decision aid.

```
==============================================================
                          MAIN MENU
      SELECT ONE:
                     BUILD FLIGHT CREW
                     MISSION SCHEDULE
                     OPERATOR INFORMATION
                     UPDATE OPERATOR INFORMATION
                     1= MISSION COMPLETION ACTIONS
                     2= MISCELLANEOUS
                     FLIGHT ORDERS
                     QUIT
==============================================================
```

Figure 4.3 Main Menu

Build Flight Crew

The build flight crew function is the heart of the 6916ESS aircrew scheduling decision aid. More than any other function in the decision aid, the build flight crew function provides the scheduler with the opportunity to exercise his judgment and choice while building a mission flight crew. Essentially, this function provides a tailored list (based on duty crew) of available operators qualified to fly a specific position chosen by the scheduler. The list of available operators includes a list of default operator characteristics: position qualifications, how much they have flown in the past 30 and 90 days, trainer or trainee qualifications, strengths as a trainer, which work crew they are assigned to, and training queue priority. This default list may be easily changed if the scheduler desires other information when making a scheduling decision. Once a scheduler has selected an operator to fly a particular position, all necessary information about that operator is automatically extracted from the data base and transferred to a spreadsheet where the mission crew is compiled.

The mission crew spreadsheet is developed from a profile spreadsheet shell. The profile shell provides space for each operator type that is required for each different mission type. Additionally, the total number of operators and the total number of crewmembers (operators, observers, and maintenance technicians) already scheduled are automatically calculated and provided in the mission crew spreadsheet. This feature will help the scheduler determine how many seats are still open for the

mission.

Mission Schedule

The mission schedule function is designed to allow the scheduler to input, change, delete, and display information about future missions. These actions are accomplished through the Enable add, edit, delete, and display data base functions. A data input form was built to assist the scheduler when adding mission data to the data base.

Operator Information

The operator information function allows the scheduler to search the POSITION relation and display the specific information he desires. The scheduler must become familiar with the Enable language to request specific information or a specific subset of a relation.

Update Operator Information

Selection of the update operator information function allows the scheduler to add, change, or delete information in the OPERATOR, POSITION, or AVAIL relations. This function asks the scheduler what information he would like to update and then opens the appropriate relation.

Mission Completion Actions

As discussed in Chapter I, there are several actions the scheduler must accomplish after a mission is completed. These actions are displayed in a submenu if the 'mission completion actions function' is selected from the main menu. This submenu is depicted in Figure 4.4.

```
=================================================================
                    MISSION COMPLETION MENU

          UPDATE MISSION HISTORY DATA BASE
          1=UPDATE OPERATOR FLIGHT HISTORY DATA BASE
          2=UPDATE 30/90 DAY FLIGHT HOUR TOTALS
                      30 DAY UPDATE
                      90 DAY UPDATE
          ADD INDIVIDUAL HOURS (E-3A, C-130, ETC.)
          RETURN TO MAIN MENU

=================================================================
```

Figure 4.2 Mission Completion Menu

The update mission history data base activity involves updating the MSNHISTY relation. The system takes the scheduler directly to the MSNHISTY relation and displays an input form which requests required data from the scheduler.

The update operator flight history data base activity updates the OPHISTY relation. The system will prompt the scheduler for the mission number of the completed mission. The system will prompt the scheduler for required information. The majority of the information required for the relation update is taken from the mission crew spreadsheet. Other than the few prompts the system makes for required information, the relation update is done automatically by the system.

The update 30/90 day hours activity updates the 30 and 90 day flight hour fields in the OPERATOR relation. The system prompts the scheduler for the 30 and 90 day windows and then automatically extracts the proper data from the OPHISTY relation. This data is then transferred to a spreadsheet where the 30 and

90 day flight hours are calculated for each operator. Once the hours have been calculated, the OPERATOR relation is updated from the spreadsheet. Except for providing the 30 and 90 day windows to the system, this entire process is transparent to the scheduler. Extensive testing has verified this function works as expected.

The "add individual hours" activity was added to the system because many 6916ESS operators occasionally fly with other units and on different types of aircraft. As a result, a capability was required to allow the scheduler to update the data base with these individual hours.

Flight Orders

The flight orders function was designed to automatically format and then print the flight orders for the scheduler once the mission crew was finalized. The system takes information from the mission crew spreadsheet (mission number, mission date name, social security number, and rank) and prompts the scheduler for other information required for the flight orders. The information is put in the proper format in a word processing file ready for printing whenever the scheduler desires.

Miscellaneous Activities

The miscellaneous activities function helps the scheduler keep track of required recurring training as explained in Chapter I (SV-83, Life Support, Physiological, and Flight Physicals).

Two capabilities were built into the system that do not come under any specific heading. First, the system has a "notepad"

capability that the scheduler can use to make notes to himself. This will help the schedulers to remember information and not disrupt the scheduling process to any large extent. Second, a rotating shift schedule was developed inside a spreadsheet. The shift schedule is a memory jogger for the scheduler to keep track of which crew is working which shift on a given day.

Although the 6916ESS aircrew scheduling decision aid in its current form meets many of the requirements of the scheduling decision process, the decision aid could be improved. Chapter V discusses recommended improvements and expansions for the system. Additionally, Chapter V discusses recommendations and conclusions concerning the application of the adaptive design methodology to the 6916ESS aircrew scheduling decision aid design and implementation process.

V RECOMMENDATIONS AND CONCLUSIONS

Introduction

This chapter discusses recommendations and conclusions in two areas. First, recommended improvements or additions to the specific 6916ESS scheduling decision aid are discussed. Second, recommendations and conclusions concerning the adaptive design methodology as applied to building the 6916ESS decision aid are reviewed.

6916ESS Scheduling Decision Aid Enhancement

Recommended changes and additions for the 6916ESS scheduling decision aid were documented throughout the design and implementation phases by using a "hook book." A "hook book" is a collection of ideas for system enhancement that formulate during the adaptive design process but which are not implemented due to time constraints, technological barriers, cost, and/or the concept of adaptive design which suggests rapid implementation and evolution. Since one of the precepts of the adaptive design process is an evolving system, there must be a process established to capture the direction and ideas for system enhancement and expansion. The "hook book" concept meets this need. A "hook book" can be implemented in many different ways -- from a formal process to an informal process. A formal process might involve having the builder and user meet at set intervals to discuss proposed changes to the system which the user has formally documented. An informal "hook book" process might involve the user jotting down notes about the system on scratch paper or in a system word processing file. The builder of this decision aid kept his "hook book" in a notebook with other system

documentation. The 6916ESS scheduling decision aid provides the schedulers the opportunity to keep the system with the 'notebook' capability provided in the system.

The 'hook book' items or system enhancements discussed here are not in priority order because they were not discussed with the user. However, if the 6916ESS scheduling decision aid had been built in the field, the 'hook book' items would be aggregated and then prioritized by the system referee. The system referee is the official responsible for resolving conflicts concerning system usage and system changes.

Overall System Expansion. The 6916ESS scheduling decision aid has a high potential for system expansion. Since several sections within the Operations Branch use common data on mission performance and operator attributes, the data base was built to allow for expansion to other sections.

The Collection Management Section is responsible for maintaining and analyzing mission statistics. As a result, they require data on mission types, duration, watch time, orbit time, status, remarks, collection time, and type of collection. This mission data is used to determine mission effectiveness and to explore ways to increase that effectiveness. Some of this data is already contained in the data base (see Chapter IV). The current data base could be easily expanded to include all the data required by the Collection Management Section.

The Training Section personnel are responsible for monitoring all training in the Operations Branch. As such, they require data on each trainee's status and which instructors they

have flown with. This information is used to provide recommendations to the Operations Officer and the Chief of Operations Production. Much of this data can be obtained from the current data base with the proper data base queries.

The Standardization and Evaluation (Stan/Eval) Section is responsible for conducting the Operations Branch evaluation program. This section must keep track of when evaluations are due and schedule evaluators to conduct evaluations. There is already a field in the data base for evaluation due dates for use by both the schedulers and the Stan/Eval section and could be used as an automatic suspense file.

A networked system would allow all sections to share a common data base. This would require a strong data base management system which would include a data manager. The data manager is responsible for maintaining the integrity of the data base. As such, the data manager would develop procedures to ensure only specifically identified individuals or sections are allowed to change data in the data base. This type of system would also require a strong model base management system similiar to the data base management system to ensure only those authorized could modify menus, macro procedures, and other system models.

Model Base. The model base could be enhanced in several ways. The 6916ESS schedulers are frequently asked to project the status of the squadron's mission capabilities in the future so that squadron management can make planning decisions. For example, if part of the squadron is tasked to deploy and they must also continue home station operations, squadron management

will want to know how long they will be able to continue home station operations before operators start exceeding the 30 and 90 day flight hour limits. Or, if the squadron is faced with a glut of trainees and a large projected departure of experienced operators, squadron management will want to know what capabilities they will have when the departures are the greatest. Finally, during times of crises, the 6916ESS may be tasked to fly more often and for more hours. In this case, squadron management will want to know how long they will be able to maintain expanded operations before training and administrative paperwork are significantly degraded. These questions could be analyzed through implementation of forecasting and simulation models in the decision aid's model base. The data structures required for these models already exist in the data base. However, a significant effort would be required to interface the models with the data base.

Presently, the decision aid helps the scheduler build and change mission flight crews by providing the scheduler with a list of operators available to fly and the operator's attributes. It is up to the scheduler to use his judgment when comparing the operator's attributes to determine which operators are selected to fly. An expert system could be designed to capture the scheduler's judgment and heuristic rules used when selecting one operator over another. The expert system could be integrated into the model base and designed to access the data base. Since the expert system would be built using the schedulers own judgmental rules and heuristics, it could further help the

scheduler produce more efficient and effective mission flight crew schedules by saving time and not making mistakes.

Miscellaneous. Since many operators fly more than one mission in a row (i.e. fly on two consecutive days), a slip in take off time or an extension of mission duration may mean the operator cannot fly the next day's mission due to crew rest limitations. The system should have the capability to highlight those operators scheduled to fly on consecutive days. This capability would help the schedulers to quickly identify those operators who need to be replaced and quickly provide potential replacements. This capability could be provided by developing a macro procedure to search the next day's mission spreadsheet for the operator in question.

Recommendations for HQ Electronic Security Command.

HQ ESC should consider fielding the 6916ESS scheduling decision aid. The 6916ESS could act as a test location to see if the system is effective in the field. If the scheduling decision aid proves to be successful, HQ ESC should plan to field similiar systems to the other ESC airborne units. During the test and evaluation at the 6916ESS, the system will probably evolve to be even more specific to the 6916ESS. As a result, HQ ESC would also have to decide what version of the 6916ESS scheduling decision aid to implement since each airborne unit has different types of operators and slightly different missions. HQ ESC should also consider the feasibility of implementing similiar systems at the 6911ESS and the 6903ESS who have missions similiar to the ESC airborne units.

The ENABLE software package proved to be effective and flexible when building the 6916ESS decision aid. The cost to the government of the ENABLE software package is inexpensive (approximately $80). Because of its integrated word processing, spreadsheet, and data base capabilities, many applications at the squadron, wing, and MAJCOM could be implemented using the ENABLE or similiar software capability. As a result, HQ ESC should consider providing ENABLE or a similiar software capability to each of its squadrons and wings.

To ensure effective and efficient performance of programs implemented with ENABLE, the personal computers used should have 10 to 20 megabytes of hard drive disk space. This will ensure the programs run faster and the user does not have to bother changing floppy disks during execution. Also, many applications may require more disk space than available on one 360 kilobyte floppy diskette (e.g. the 6916ESS scheduling decision aid requires slightly more than 360 kilobytes which includes the data base, menus, spreadsheets, and macro procedures). The Zenith Z-248 with a 20 megabyte hard drive and color monitor proved to be an excellent computer to host the 6916ESS scheduling decision aid.

If HQ ESC decides to provide its squadrons with ENABLE or a similiar software capability and Z-248 or similiar computers, training is essential. The ENABLE software capability is extensive and if the squadrons are to exploit this power, they need some people trained to use it. Since the quality of personnel in ESC has traditionally been high and since most are computer literate, only one or two people would require formal

training. Those people receiving the formal training could teach the rest of the squadron.

System Evaluation. System evaluation is an important element of the adaptive design process. Not only does the computer code used to build the system need to be verified, but system effectiveness also needs to be evaluated. The computer code written to build the 6916ESS scheduling decision aid has been verified by the builder. Since the builder has an adequate working knowledge of the scheduling process, each decision aid function was tested to ensure proper performance. Several example mission crews were scheduled to fly missions using the 6916ESS scheduling decision aid. Mission Flight Orders were automatically produced when requested for the simulated crews. Additionally, all mission completion tasks (e.g. update mission history and operator history data relations and calculation of 30 and 90 day flight hours).

A System effectiveness evaluation has not been completed because of the lack of interaction with the user. A system effectiveness evaluation should consider all aspects of the decision aid: the system itself, the user, the environment, and the task. To properly evaluate the system, the scheduling decision aid needs to be given to the 6916ESS and used by the schedulers. Although many of the decision aid's benefits are more qualitative than quantitative (e.g. more alternatives examined, improved communications between sections, etc.), there are some quantitative aspects of the system that can be measured.

Since one of the objectives of the 6916ESS scheduling

decision aid is to save the scheduler some time in making a crew selection, time is an important measure of system effectiveness. In order to evaluate this measure of effectiveness, the time required to perform the scheduler functions (e.g. select an entire mission crew, find a replacement operator, complete the flight orders, compute 30 and 90 day flight hours, etc.) manually and with the use of the decision aid should be compared. The 6916ESS schedulers have been asked to keep records of the time required to complete the scheduling functions manually. If the use of the decision aid does not save time, either it must be designed to work faster or the system should be seriously considered for cancellation if the crews selected with the help of the decision aid are no better then using the manual method. Another measure of effectiveness is system response time. If the system is too slow in reacting to the user commands, the decision process is interrupted and thus the scheduler's decision making effectiveness could decrease. This evaluation criteria can be measured by observing the scheduler using the decision aid and from feedback given by the scheduler.

The time required for the scheduler to learn how to use the system is important. If it takes too long for the scheduler to learn how to use the system, it may not be worth implementing. The exact point at which the user is said to have "learned the system" is difficult to determine. However, the number of times a user requires assistance from the user's guide for routine operations and the number of errors the user makes when proceeding through the decision process could be used to help determine the point at which a user has "learned the system."

Selection of a qualified mission flight crew, while flying as many trainees as possible, is another objective of the 6916ESS scheduling decision aid. Since squadron management would not allow a mission to be canceled because a qualified crew was not scheduled, the number of missions canceled because of a scheduler's error cannot be used to measure crew scheduling effectiveness. As a result, this system objective is difficult to measure directly and requires psuedo-measures such as: comparing the number of times a scheduler tries to assign an unavailable or unqualified operator during manual scheduling versus the number of times these mistakes are made when using the decision aid. Squadron management could also subjectively compare mission flight crews scheduled manually and those scheduled using the decision aid in areas such as: experience mix, number of trainees scheduled, changes required because of qualification or availability mistakes, number of trainer/trainee mismatches, and the number of open seats.

The final and perhaps the most important measure of system effectiveness is system usage -- or more simply does the scheduler like the decision aid and does he use it. This item can be measured by asking the user or having the user keep a log of system usage and recommendations for system improvement.

<u>Adaptive Design Methodology</u>.

The adaptive design methodology proved to be an effective way of building the 6916ESS scheduling decision aid. The strengths of the adaptive design methodology as discussed in Chapter II proved to be true during this research project. The

Representation, Operations, Memory Aids, and Control Aids (ROMC) approach as executed through the storyboarding process was quite effective in helping to define requirements. The adaptive design methodology allowed the system to be designed and partially implemented without having all the requirements "finalized" because requirements are never final. This encourages more experimentation during system design and implementation. The freedom to experiment leads to a more robust system and more entries in the "hook book." An atmosphere conducive to generating ideas for system enhancement and expansion requires a system to capture these ideas. When multiple users maintain individual "hook books", a referee is needed to consolidate and/or resolve conflicts among ideas for implementation.

Although the adaptive design methodology was effective, it also had some drawbacks. One of the primary reasons adaptive design can be effective is a strong and frequent builder - user interaction. Due to the distance and lack of timely communications between the 6916ESS and AFIT, there was very little builder - user interaction. As a result, the design and implementation processes were not as effective as they could have been. With constant builder - user interaction, the design and implementation phases could have been accomplished much quicker.

Recommendations. Once a decision aid is fielded and becomes operational, it must continue to evolve to meet changing requirements and conditions or it will cease to be effective. The organization needs to set up a planning and design mechanism to ensure the system continues to evolve. This process must

include a system to record user complaints and suggested improvements, fix shortcomings, implement suggested improvements, and document any changes to the system. As discussed earlier, the "hook book" system is an effective way to record user recommendations for system changes and can be implemented with either formal or informal procedures.

The Builder's Perspective. From the builder's perspective, the adaptive design methodology is an effective way of designing, building, and implementing decision aids. The lack of timely and frequent interaction with the user caused several problems and highlighted the importance of this interaction during the adaptive design process. Since the builder did not have an extensive computer background prior to building the 6916ESS scheduling decision aid, the adaptive design methodology proved to be a useful roadmap for decision aid development. The experience gained during this project shows that adaptive design can also be successfully implemented at the squadron level as more powerful computer hardware and software provide squadron's with the capability to design, build, and implement their own computer-based decision aids.

APPENDIX A

STORYBOARDS

This appendix contains a sample selection of the storyboards developed dùring the adaptive design process. They have been left in original format to emphasize the fact that they were made quickly and are best left in rough form. The storyboards may be changed at any time due to new requirements of other situation changes. The storyboards have been reduced in size to comply with margin restrictions.

MAIN MENU

SELECT ONE:

BUILD FLIGHT CREW
MISSION SCHEDULING
OPERATOR INFORMATION
UPDATE OPERATOR INFORMATION
UPDATE FLIGHT HOURS
MISCELLANEOUS
QUIT

F1-HELP F2-SAVE F3-MAINMENU F4-MISSION F5-BUILD F6-UPDATE F7-HOURS F8-SORT F9-QUIT

F1 - HELP - CAN ACCESS ON LINE HELP FACILITIES
F2 - SAVE - ABILITY TO SAVE A SCREEN DISPLAY IF USER NEEDS TO CHANGE SCREENS
F3 - MAINMENU - TAKES USER BACK TO THE MAIN MENU
F4 - MISSION - ABILITY TO GO DIRECTLY TO THE MISSION MENU
F5 - BUILD - ABILITY TO GO DIRECTLY TO THE BUILD CREW MENU
F6 - UPDATE - ABILITY TO GO DIRECTLY TO THE UPDATE OPERATOR INFORMATION MENU
F7 - HOURS - ABILITY TO GO DIRECTLY TO THE UPDATE FLIGHT HOURS MENU
F8 - SORT - ALLOWS USER TO GO DIRECTLY TO THE SORT SCREEN
F9 - QUIT - ALLOWS USER TO QUIT AND SAVE ANY CHANGES MADE DURING THE SESSION

```
                         MISSION DATA                          :    MAIN MENU
                                                               :> BUILD FLIGHT CREW
 WHAT MISSION WOULD YOU LIKE: ____________                     :  MISSION SCHEDULE
                                                               :  OPERATOR INFO
                31 OCTOBER 86                                  :  UPDATE OPERATOR INFO
                MISSION DL189                                  :  UPDATE FLIGHT HOURS
                MISSION TYPE: 1                                :  MISCELLANEOUS
             CREW COMPOSITION:                                 :----------------------
                                                               :> MISSION DATA
 1 - TYPE 1                 T1                                 :  HARD SCHEDULE
 2 - TYPE 2                 T2                                 :  EVALUATIONS
 3 - TYPE 3 L               T3                                 :  INPUT OBSERVERS AMT
 4 - TYPE 4 L               T4                                 :  COMPILE CREW
 5 - TYPE 5                 T5                                 :  DISPLAY CREW
 6 - TYPE 6                 T6                                 :  CHANGE CREW
 7 - TYPE 4 B/U             T7                                 :  MSN PLANNING SHEET
 8 - TYPE 7 B/U             AMT1                               :  FLIGHT ORDERS
 9 - TYPE 7 L               AMT2                               :
10 - TYPE 7 B/L             AMT3                               :----------------------
11 - TYPE 8 B/U
12 - TYPE 8 L
13 - TYPE 9

WOULD YOU LIKE TO CHANGE THE CREW COMPOSITION?  Y  N

F1-HELP F2-SAVE F3-MAINMENU F4-MISSION F5-BUILD F6-UPDATE F7-HOURS F8-SORT
F9-QUIT
```

-- WHEN THE USER TYPES IN THE MISSION NUMBER IN THE BLANK ABOVE, THE ABOVE INFORMATION WOULD BE DISPLAYED

-- THE BOXES ON THE RIGHT SHOW WHERE THE USER IS IN THE SYSTEM

-- THIS SCREEN WOULD ALLOW THE USER TO CHANGE THE CREW COMPOSITION FOR A MISSION IN RESPONSE TO DIFFERENT REQUIREMENTS. IT WOULD ALSO ALLOW THE USER TO SET THE NUMBER OF TRAINING POSITIONS THERE WILL BE FOR A PARTICULAR MISSION.

-- IF THE USER ANSWERS YES TO THE QUESTION, THE CURSOR WOULD APPEAR UNDER TYPE 1. THE USER COULD THEN POSITION THE CURSOR WHERE HE WANTED TO MAKE A CHANGE.

MAIN MENU
BUILD FLIGHT CREW
>MISSION SCHEDULE
OPERATOR INFO
UPDATE OPERATOR INFO
UPDATE FLIGHT HOURS
MISCELLANEOUS
QUIT

>ADD MISSION
CHANGE MISSION
DELETE MISSION

ADD MISSION

MISSION NUMBER
DATE

MISSION TYPE

TAKE OFF TIME
LAND TIME

EXPECTED DURATION

SHOW TIME

WOULD YOU LIKE TO ADD ANOTHER ? N

F1-HELP F2-SAVE F3-MAIN MENU F4-MISSION

F5-BUILD F6-UPDATE F7-HOURS F8-SORT F9-QUIT

-THIS ALLOWS THE USER TO INPUT THE REQUIRED INFORMATION ABOUT EACH MSN.

TO BE USED IN THE BUILD FLIGHT CREW MENU ROUTINE.

-THIS INFORMATION IS PROVIDED BY THE DOO SECTION.

Even this require a recd "in support of ——— tasking"

MAIN MENU
> BUILD FLIGHT CREW
MISSION SCHEDULE
OPERATOR INFO
UPDATE OPERATOR INFO
UPDATE FLIGHT HOURS
MISCELLANEOUS

BUILD FLIGHT CREW

SELECT ONE:

MISSION DATA
HARD SCHEDULE
EVALUATIONS
INPUT OBSERVERS AMTS
COMPILE CREW
DISPLAY CREW
CHANGE CREW
MISSION PLANNING SHEET
FLIGHT ORDERS
QUIT

F1-HELP F2-SAVE F3-MAINMENU F4-MISSION F5-BUILD F6-UPDATE F7-HOURS F8-SORT F9-QUIT

```
                 COMPILE CREW                        :    MAIN MENU
                                                     :> BUILD FLIGHT CREW
                                                     :  MISSION SCHEDULE
                                                     :  OPERATOR INFO
                                                     :  UPDATE OPERATOR INFO
FOR WHAT MISSION WOULD YOU LIKE THE CREW COMPILED?   :  UPDATE FLIGHT HOURS
      MISSION: ____________                          :  MISCELLANEOUS
                                                     :---------------------
                                                     :  MISSION DATA
                                                     :  HARD SCHEDULE
(COMPILING CREW)                                     :  EVALUATIONS
(COMPILE COMPLETE)                                   :  INPUT OBSERVERS AMT
                                                     :> COMPILE CREW
((RETURNS TO BUILD FLIGHT CREW MENU WHEN DONE        :  DISPLAY CREW
  COMPILING THE CREW)                                :  CHANGE CREW
                                                     :  MSN PLANNING SHEET
                                                     :  FLIGHT ORDERS
                                                     :
                                                     :---------------------

F1-HELP F2-SAVE F3-MAINMENU F4-MISSION F5-BUILD F6-UPDATE F7-HOURS F8-SORT
F9-QUIT
```

-- THIS WILL EXECUTE THE CREW SLECTION HEURISTIC ALGORITHM I WILL BUILD FROM THE INPUT RECEIVED FROM THE 16TH'S SCHEDULERS. EXAMPLES COULD INCLUDE BUILDING THE CREW BASED ON:

COMPATIBILITY PERSONALITY
TIME SINCE LAST FLIGHT
TRAINEE QUALIFICATIONS
QUALIFICATIONS EXPERIENCE OR USAF PRIORITY TIME
ETC.

THE FINAL HEURISTIC WILL PROBABLY BE A COMBINATION OF MANY AND WILL BE MODIFIED MANY TIMES BY THE USER

How about a variable model built around weights for a multi-attribute utility scheme?

```
INPUT OBSERVERS/AMT'S

MISSION: ________________

ENTER AMT'S:
AMT1: __________
AMT2: __________
AMT3: __________
AMT4: __________

WOULD YOU LIKE TO SCHEDULE AN OBSERVER FOR
MISSION DL1B?   Y   N
IS THE OBSERVER FROM THE 16TH?   Y   N
((IF SECOND IS YES))
     NAME: ______________

((IF SECOND ? IS NO))
     NAME: ______________
     RANK: ______________
     SSAN: ______________
     UNIT: ______________

WOULD YOU LIKE TO SCHEDULE ANOTHER OBSERVER?   Y   N

F1-HELP F2-SAVE F3-MAINMENU F4-MISSION F5-BUILD F6-UPDATE F7-HOURS F8-SORT
F9-QUIT
```

```
      MAIN MENU
  BUILD FLIGHT CREW
  MISSION SCHEDULE
  OPERATOR INFO
  UPDATE OPERATOR INFO
  UPDATE FLIGHT HOURS
  MISCELLANEOUS
---------------------
  MISSION DATA
  HARD SCHEDULE
  EVALUATIONS
  INPUT OBSERVERS AMT
  COMPILE CREW
  DISPLAY CREW
  CHANGE CREW
  MSN PLANNING SHEET
  FLIGHT ORDERS
---------------------
```

-- THE USER WOULD ENTER THE MISSION NUMBER

-- THE MAINTENANCE BRANCH PROVIDES THE NAMES OF THE AMT'S TO THE SCHEDULER

-- THE USER WOULD ENTER THE NAME OF THE OBSERVERS

-- IF THE OBSERVER IS NOT FROM THE SQUADRON, THE EXTRA INFORMATION IS REQUIRED FOR THE FLIGHT ORDERS

```
                    DISPLAY FLIGHT CREW                       :      MAIN MENU
                                                              :  BUILD FLIGHT CREW
ENTER MISSION NUMBER: __________                              :  MISSION SCHEDULE
                                                              :  OPERATOR INFO
                    31 OCTOBER 1986                           :  UPDATE OPERATOR INFO
                    MISSION: DL189                            :  UPDATE FLIGHT HOURS
                    MISSION TYPE: 1                           :  MISCELLANEOUS
            CREW:                                             :----------------------
1 - POWELL                  T1 - KOFF - OBS.                  :  MISSION DATA
2 - TAYLOR                  T2 - HAYDEN - POS 4               :  HARD SCHEDULE
3 - DIBERT                  T3 - VALUSEK - POS 11             :  EVALUATIONS
4 - BROCK                   T4 - SCHOECK - POS 1              :  INPUT OBSERVERS AMT
5 - SALO                    T5 - TRAPP - POS 6                :  COMPILE CREW
6 - OLSOVSKY                T6 - GRECHANIK - POS 5            :  DISPLAY CREW
7 - JACKSON, R.             T7 - LUTZ - POS 10                :  CHANGE CREW
8 - TRAVIS                                                    :  MSN PLANNING SHEET
9 - FURGURSON                AMT1 - STONE                     :  FLIGHT ORDERS
10 - WINDER                  AMT2 - BRAUN                     :
11 - SKEEN                   AMT3 - FERRERA                   :----------------------
12 - KNOX
13 - OGLESBY          WOULD YOU LIKE TO CHANGE THE CREW?  Y  N

F1-HELP F2-SAVE F3-MAINMENU F4-MISSION F5-BUILD F6-UPDATE F7-HOURS F8-SORT
F9-QUIT
```

-- THE USER CAN DISPLAY THE CREW THE HEURISTIC SELECTED. IF THE USER WOULD LIKE TO CHANGE THE CREW, THE SYSTEM WILL GO TO THE NEXT SCREEN.

Explanation capability for look-back

- This utility would eventually evolve to a ESS using AI with a data base to "populate" the AI rules.

```
                     CHANGE CREW                                  :     MAIN MENU
                                                                  :> BUILD FLIGHT CREW
ENTER MISSION NUMBER: ____________                                :  MISSION SCHEDULE
                      CREW:                                       :  OPERATOR INFO
1 - POWELL       95/210    T1 - KOPP/OBS.         16/48           :  UPDATE OPERATOR INFO
2 - TAYLOR       100/220   T2 - HAYDEN POS 4      79/194          :  UPDATE FLIGHT HOURS
3 - GIBERT       85/170    T3 - VALUSEK/POS 11    14/14           :  MISCELLANEOUS
4 - BROOK        70/251    T4 - SCHOECK/POS 1     97/292          :----------------------
5 - SALO         105/270   T5 - TRAPP POS 6       29/113          :  MISSION DATA
6 - OLSOVSKY     40/150    T6 - GRECHANIK POS 5   0/0             :  HARD SCHEDULE
7 - JACKSON      66/190    T7 - LUTZ/POS 10       79/247          :  EVALUATIONS
8 - TRAVIS       36/125    AMT1 - STONE                           :  INPUT OBSERVERS
9 - FURGURSON    84/231    AMT2 - BRAUN                           :  COMPILE CREW
10 - WINDER      90/267    AMT3 - FERRERA                         :  DISPLAY CREW
11 - SKEEN       111/302                                          :  CHANGE CREW
12 - KNOX        58/163                                           :  MSN PLANNING SHEET
13 - OGLESBY     34/137                                           :  FLIGHT ORDERS
WOULD YOU LIKE TO AT CHOICES FOR A POSITION? Y/N
          POSITION NUMBER: ______                                  ----------------------
WOULD YOU LIKE THE SYSTEM TO SELECT A REPLACEMENT? Y/N
((IF YES))   (SYSTEM SELECTING REPLACEMENT)
             (REPLACEMENT SELECTED)
((IF NO))    ENTER NEW OPERATOR NAME: ______________
WOULD YOU LIKE TO CHANGE ANOTHER POSITION? Y/N

F1-HELP F2-SAVE F3-MAINMENU F4-MISSION F5-BUILD F6-UPDATE F7-HOURS F8-SORT
F9-QUIT
```

-- IF THE USER WOULD LIKE ~~TO~~ THE SYSTEM TO TRY ~~AND~~ TO FIND A REPLACEMENT A HEURISTIC SIMILIAR TO THE ONE THAT SELECTS THE CREW WILL BE USED

-- IF THE USER WOULD LIKE TO DISPLAY POSSIBLE CHOICES FOR A POSITION, A SCREEN WILL APPEAR WITH ALL THE AVAILABLE OPERATORS WHO CAN FLY THAT POSITION AND THE FLIGHTS THAT OPERATOR HAS HAD OVER THE PAST 25 DAYS SIMILIAR TO THE FOLLOWING:

POSITION 1 AVAILABLE OPERATORS

DATES OPERATOR FLEW

NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
O'CONNELL		X	X				X		X		X	X				X	X			X	X				
SKEEN	X					X		X					X	X				X						X	X
WILSON			X			X					X				X	X						X	X		
CARPENTER	X			X	X						X	X	X				X			X	X			X	

MISSION PLANNING SHEET

ENTER MISSION NUMBER: ____________

POS	NAME	QUAL	REMARKS		
1	POWELL	Q		30	90
2	TAYLOR	Q		95	210
3	DIBERT	III		100	220
4	BRODY	III		85	170
5	SALO	III		70	250
6	OLSON.SKY	Q		105	270
7	JACKSON	III		40	150
8	TRAVIS	III		66	190
9	FURGURSON	III		26	125
10	WINDER	III		84	201
11	SKEEN	III		90	267
12	KNOX	III		111	302
13	OGLESBY	Q		58	167
OBS	KOFF	Q		34	137
T1	SCHOEDY	U		16	48
T4	HAYDEN	II		97	292
T5	GRECHANIK	I	OBS FLT	79	194
T6	TRAPP	U		0	0
T10	LUTZ	II		29	113
T11	VALUSEK	I		79	247
AMT1	STONE			14	14
AMT2	BRAUN				
AMT2	FERRERA				

[illegible]

MAIN MENU
1) BUILD FLIGHT CREW
MISSION SCHEDULE
OPERATOR INFO
UPDATE OPERATOR INFO
UPDATE FLIGHT HOURS
MISCELLANEOUS

MISSION DATA
HARD SCHEDULE
EVALUATIONS
INPUT OBSERVERS
COMPILE CREW
DISPLAY CREW
CHANGE CREW
MSN PLANNING SHEET
FLIGHT ORDERS

DOT:

DOV:

DOR:

DO:

WOULD YOU LIKE TO PRINT THE MPS ON THE PRINTER? Y N

F1-HELP F2-SAVE F3-MAINMENU F4-MISSION F5-BUILD F6-UPDATE F7-HOURS F8-SORT F9-QUIT

-- THE MPS IS A REQUIRED FORM BY REGULATION AND ALLOWS THE MAJOR OPERATIONS SECTIONS TO COORDINATE ON THE SCHEDULE BEFORE FINAL OPS OFFICER (DO) APPROVAL

FLIGHT ORDERS

ENTER MISSION: ____________________

Name	Number
*POWELL, MICHEAL G., MSGT	000-00-0000
TAYLOR, WILLIAM D., TSGT	000-00-0000
DIBERT, THOMAS R., SRA	000-00-0000
BROCK, BARON S., SSGT	000-00-0000
SALO, GENE O., SSGT	000-00-0000
OLSOVSKY, MICHEAL R., SSGT	000-00-0000
JACKSON, MERRITT R., SGT	000-00-0000
TRAVIS, MICK D., SSGT	000-00-0000
FURGUERSON, MICHAEL T., MSGT	000-00-0000
WINDER, JOHN H., SMSGT	000-00-0000
SKEEN, STEWART R., TSGT	000-00-0000
KNOX, WALLACE J., CMSGT	000-00-0000
OGLESBY, MARK F., SGT	000-00-0000
KOFF, THOMAS J., CAPT	000-00-0000
HAYDEN, THOMAS A., TSGT	000-00-0000
VALUSEK, JOHN R., SRA	000-00-0000
SCHOECK, JAMES R., MSGT	000-00-0000
TRAFF, PAUL E., SRA	000-00-0000
GRECHANIK, JEFFREY F., SSGT	000-00-0000
LUTZ, ROLLIN J., SSGT	000-00-0000
STONE, BRIAN J., SGT	000-00-0000
BRAUN, STEVE F., SRA	000-00-0000
FERREFA, DAVID E., MSGT	000-00-0000

MAIN MENU
- > BUILD FLIGHT CREW
- MISSION SCHEDULE
- OPERATOR INFO
- UPDATE OPERATOR INFO
- UPDATE FLIGHT HOURS
- MISCELLANEOUS

- MISSION DATA
- HARI SCHEDULE
- EVALUATIONS
- INPUT OBSERVERS
- COMPILE CREW
- DISPLAY CREW
- CHANGE CREW
- MSN PLANNING SHEET
- FLIGHT ORDERS

F1-HELP F2-SAVE F3-MAINMENU F4-MISSION F5-BUILD F6-UPDATE F7-HOURS F8-SORT F9-QUIT

-- THIS WOULD ALLOW THE USER TO PRINT OUT THE FLIGHT ORDERS AUTOMATICALLY -- A REAL TIME SAVER OVER DOING IT MANUALLY IN A TYPEWRITER

and virtually no software development expense! (if they maintain the data base

```
                LISTING SORTS                              MAIN MENU
                                                         BUILD FLIGHT CREW
TYPE SPECIFICATION FOR SORT:                             MISSION SCHEDULE
SPECIFICATION: ______________________________          : OPERATOR INFO
                                                         UPDATE OPERATOR INFO
                                                       : UPDATE FLIGHT HOURS
                                                       : MISCELLANEOUS
                                                       --------------------
                                                         REMOVE AN OPERATOR
                                                         ADD AN OPERATOR
                                                       : LISTINGS SORTS

                                                       --------------------

F1-HELP F2-SAVE F3-MAINMENU F4-MISSION F5-BUILD F6-UPDATE F7-HOURS F8-SORT
F9-QUIT
```

-- THIS ROUTINE WILL ALLOW THE USER TO EXTRACT SORTS FROM THE DATA BASE LIKE A LIST OF ALL CAT III TYPE 8 OPERATORS THAT ARE NOT AVAILABLE OR ANY OTHER COMINATION OF ATTRIBUTES AN OPERATOR HAS (ALL CAT III TYPE 8 LEAD OPERATORS THAT ARE TRAINEES). IF THE USER REQUIRES HELP IN FORMULATING A SORT COMMAND, HE CAN FIND IT BY DEPRESSING THE HELP KEY (F1)

--THIS ROUTINE WILL BE VERY IMPORTANT WHEN FILLING IN A CREW (PROVIDES THE "CHOICES"). IT WILL ALSO COME IN VERY HANDY FOR SPECIAL REQUESTS FOR INFORMATION FROM THE OPS OFFICER OR OPS SUPERINTENDENT.

```
                                                        :   MAIN MENU
                ADD AN OPERATOR                         :  BUILD FLIGHT CREW
                                                        :  MISSION SCHEDULE
WHAT RECORD WOULD YOU LIKE TO ADD?                      :  OPERATOR INFO
                                                        :  UPDATE OPERATOR INFO
LAST NAME: ________________                             :  UPDATE FLIGHT HOURS
FIRST NAME: ________________                            :  MISCELLANEOUS
MIDDLE INITIAL: ____________                            --------------------
RANK: __________                                        :  REMOVE AN OPERATOR
SSAN: ______________                                    .  ADD AN OPERATOR
OPERATOR TYPE: ______________                           :  LISTINGS SORTS
QUALIFICATION: ______________                           :
TRAINING STATUS: ____________                           :
EVAL DATE: ______________                               :
FLIGHT/CREW: ______________                             :

WOULD YOU LIKE TO ADD ANOTHER RECORD?  Y    N           :
                                                        --------------------

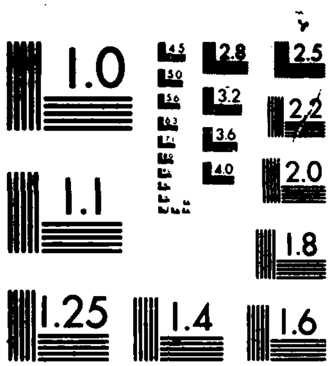
F1-HELP F2-SAVE F3-MAINMENU F4-MISSION F5-BUILD F6-UPDATE F7-HOURS F8-SORT
F9-QUIT
```

-- ALLOWS THE USER TO CREATE A RECORD WHEN SOMEONE [illegible]

AD-A185 362 DESIGN OF AN AIRCREW SCHEDULING DECISION AID FOR THE 6916TH ELECTRONIC SE..(U) AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOOL OF ENGI.. T J KOPF

2/2

UNCLASSIFIED JUN 87 AFIT/GST/ENS/87M-9 F/G 1/2 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

MAIN MENU
BUILD FLIGHT CREW
MISSION SCHEDULE
OPERATOR INFORMATION
>UPDATE OPERATOR INFO
UPDATE FLIGHT HOURS
MISCELLANEOUS
QUIT

UPDATE ABSENCES
PURGE OLD ABSENCES
>POSITION QUALIFICATION
TRAINING STATUS QUEUE
TRAINER QUALIFICATION
EVALUATION STATUS
EXPERIENCE LEVEL
RETURN TO MAIN MENU
QUIT

POSITION QUALIFICATION

WHAT OPERATOR NEEDS AN UPDATE?
NAME: ______________________

OPERATOR HAS THE FOLLOWING QUALIFICATIONS.

PRIMARY:	AMS	C
SECOND:	AA	C
THIRD:	TYPE BL	III
FOURTH:	TYPE B B/U	II
FIFTH:	CTC	III

WOULD YOU LIKE TO MAKE ANOTHER UPDATE?
Y N

F1-HELP F2-SAVE F3-MAIN MENU F4-MISSION
F5-BUILD F6-UPDATE F7-HOURS F8-SORT F9-QUIT

-MANY OPERATORS HAVE MORE THAN ONE QUALIFICATION. USE THIS WHEN SOMEONE UPGRADES OR GETS DECERTIFIED. THIS INFORMATION PROVIDED BY THE STAN EVAL SECTION.

MAIN MENU
BUILD FLIGHT CREW
MISSION SCHEDULE
OPERATOR INFORMATION
>UPDATE OPERATOR INFO
UPDATE FLIGHT HOURS
MISCELLANEOUS
QUIT

UPDATE ABSENCES
POSITION QUALIFICATION
TRAINING STATUS QUEUE
TRAINER QUALIFICATION
>EVALUATION STATUS
EXPERIENCE LEVEL
RETURN TO MAIN MENU
QUIT

EVALUATION STATUS

WHAT OPERATOR NEEDS AN UPDATE?
NAME: ______________________

OPERATOR HAS THE FOLLOWING EVALUATION STATUS.
POSITION: AA
TYPE EVAL: Q
EVAL DUE: 15 NOV 86
NUMBER OF FLIGHTS LEFT BEFORE EVAL: 5

WOULD YOU LIKE TO MAKE ANOTHER UPDATE?
Y N

F1-HELP F2-SAVE F3-MAIN MENU F4-MISSION
F5-BUILD F6-UPDATE F7-HOURS F8-SORT F9-QUIT

-SELF EXPLANATORY HOPEFULLY. I CAN WRITE A ROUTINE TO AUTOMATICALLY DECREMENT THE NUMBER OF FLIGHTS LEFT AFTER EACH TRAINING FLIGHT.

UPDATE ABSENCES

WHAT OPERATOR NEEDS AN ABSENCE UPDATE?
NAME: ____________________

WOULD YOU LIKE TO ADD OR DELETE FROM THE
ABSENCE LIST?   1-ADD   2-DELETE

((IF 1 CHOSEN THEN))
ENTER PERIOD OPERATOR WILL BE ABSENT:
FROM ______ TO ______

REASON: ____________ 1.DNIF
2.LEAVE
3.TDY
4.APPT
5.MISC

WOULD YOU LIKE TO MAKE ANOTHER UPDATE?
Y   N

((IF 2 CHOSEN THEN))
OPERATOR HAS BEN DELETED FROM THE ABSENCE LIST.
WOULD YOU LIKE TO MAKE ANOTHER UPDATE?
Y   N

BUILD FLIGHT CREW
MISSION SCHEDULE
OPERATOR INFORMATION
>UPDATE OPERATOR INFO
UPDATE FLIGHT HOURS
MISCELLANEOUS
QUIT

>UPDATE ABSENCES
PURGE OLD ABSENCES
POSITION QUALIFICATION
TRAINING STATUS QUEUE
TRAINER QUALIFICATIONS
EVALUATION STATUS
EXPERIENCE LEVEL
RETURN TO MAIN MENU
QUIT

F1-HELP F2-SAVE F3-MAIN MENU F4-MISSION

F5-BUILD F6-UPDATE F7-HOURS F8-SORT F9-QUIT

THIS SCREEN CONSOLIDATED DIFFERENT SCREENS FOR EACH TYPE OF ABSENCE (ADAPTIVE DESIGN)

Good idea
(it was mine, wasn't it?)

TRAINING STATUS/QUEUE	MAIN MENU
	: BUILD FLIGHT CREW
	: OPERATOR INFORMATION
	:>UPDATE OPERATOR INFO
WHAT OPERATOR NEEDS AN UPDATE?	: UPDATE FLIGHT HOURS
NAME: __________.	: MISCELLANEOUS
	: QUIT
OPERATOR HAS A TRAINING(QUEUE) STATUS OF: 1	
RECOMMENDED HE FLY WITH: (KNOX)	: UPDATE ABSENCES
	: POSITION QUALIFICATION
POSITION/TYPE: POS 12	:>TRAINING STATUS/QUEUE
STATUS: 1	: TRAINER QUALIFICATIONS
RECOMMENDED NEXT TRAINER: (KNOX)	: EVALUATION STATUS
	: EXPERIENCE LEVEL
	: RETURN TO MAIN MENU
	: QUIT
WOULD YOU LIKE TO MAKE ANOTHER UPDATE? Y N	

TRAINING STATUS: 1-TOP PRIORITY FOR A FLIGHT
2-PRIORITY FOR A FLIGHT
3-FLY IF SEAT AND INSTRUCTOR AVAILABLE
4-LAST PRIORITY FOR A FLIGHT
5-DO NOT FLY

F1-HELP F2-SAVE F3-MAIN MENU F4-MISSION

F5-BUILD F6-UPDATE F7-HOURS F8-SORT F9-QUIT

-TO HELP SCHEDULE TRAINERS IN SOME KIND OF ORDER WITH A COMPUTER ROUTINE (HEURISTIC). TRAINERS HAVE TO BE PUT IN SOME KIND OF PRIORITY ORDER. THIS HEURISTIC WILL BE DEVELOPED WITH INPUT FROM THE USER.

MAIN MENU
BUILD FLIGHT CREW
MISSION SCHEDULE
OPERATOR INFORMATION
>UPDATE OPERATOR INFO
UPDATE FLIGHT HOURS
MISCELLANEOUS
QUIT

UPDATE ABSENCES
TRAINING STATUS QUEUE
TRAINER QUALIFICATION
EVALUATION STATUS
>EXPERIENCE LEVEL
RETURN TO MAIN MENU
QUIT

EXPERIENCE LEVEL

WHAT OPERATOR NEEDS AN UPDATE?
NAME: ________________________.

OPERATOR CURRENTLY HAS THE FOLLOWING EXPERIENCE LEVELS:

PRIMARY: AMS	5
SECONDARY: TYPE LEAD	5
THIRD: AA	3
FOURTH: TYPE B/U	5
FIFTH: CTC	3

WOULD YOU LIKE TO MAKE ANOTHER UPDATE?
Y N

EXPERIENCE LEVEL: 0-NOT QUALIFIED
1-LEAST EXPERIENCED
2-
3-
4-
5-MOST EXPERIENCED

F1-HELP F2-SAVE F3-MAIN MENU F4-MISSION

F5-BUILD F6-UPDATE F7-HOURS F8-SORT F9-QUIT

-SIMILAR TO THE COMMENT ABOUT SCHEDULING TRAINEES, THE USER GOES THROUGH SOME TYPE OF HEURISTIC METHOD WHEN SCHEDULING A CREW THAT CONCERNS THE EXPERIENCE LEVEL OF THE OPERATORS/CREW. IN ORDER FOR A COMPUTER HEURISTIC TO HELP THE USER DO THE SAME, THE EXPERIENCE LEVEL MUST BE QUANTIFIED.

```
                                                            :   MAIN MENU
            PHYSIOLOGICAL TRAINING                          :  BUILD FLIGHT CREW
                                                            :  MISSION SCHEDULE
WOULD YOU LIKE TO: 1 - UPDATE PHYSIOLOGICAL TRAINING        :  OPERATOR INFO
                       DUE DATES                            :  UPDATE OPERATOR INFO
                   2 - DISPLAY LIST OF OPERATORS DUE        :  UPDATE FLIGHT HOURS
                       PHYSIOLOGICAL TRAINING               :> MISCELLANEOUS
((IF 1 CHOSEN))                                             :---------------------
WHICH OPERATOR NEEDS UPDATE?                                :> PHYSIOLOGICAL TRNG
NAME: ____________                                          :  SV-83 TRNG
NEW DUE DATE: _______________                               :  LIFE SUPPORT TRNG
                                                            :  FLIGHT PHYSICALS
WOULD YOU LIKE TO UPDATE ANOTHER OPERATOR'S                 :
DUE DATE?    Y    N                                         :
                                                            :
((IF 2 CHOSEN))                                             :---------------------

LIST OPERATORS DUE PHYSIOLOGICAL TRAINING IN THE NEXT:
                    1 - 30 DAYS
                    2 - 45 DAYS
                    3 - 60 DAYS
                    4 - 90 DAYS
                    5 - 120 DAYS        CHOOSE ONE: _____

NAME                          DUE DATE



F1-HELP F2-SAVE F3-MAINMENU F4-MISSION F5-BUILD F6-UPDATE F7-HOURS F8-SORT
F9-QUIT
```

-- THIS ALLOWS THE USER TO UPDATE AN OPERATORS PHYSIOLOGICAL TRAINING AND ALSO DISPLAYS OPERATORS WHO ARE DUE PHYSIOLOGICAL TRAINING. IF AN OPERATOR MISSES HIS TRAINING DUE DATE HE IS GROUNDED, SO THIS IS A GOOD THING TO KEEP CLOSE TRACK OF.

APPENDIX B

USER'S GUIDE

For

6916th Electronic Security Squadron

Scheduling

Decision Aid

This manual is designed for the 6916ESS schedulers who will use this system. Since the system is somewhat complicated and involves transferring data between different software applications, the user should be familiar with the ENABLE software package before using this decision aid. The User's Guide does provide some examples of common decision aid operations and includes example screen displays. Additional technical information concerning this decision aid can be found in Appendix C.

USER'S GUIDE

This manual is divided into eight sections corresponding to the options in the main menu, a section concerning system start up and general information, and a list of executable menus:

Section 1: System Start-up & General Information
Section 2: Build Flight Crew
Section 3: Mission Schedule
Section 4: Operator information
Section 5: Mission Completion Actions
Section 6: Miscellaneous
Section 7: Flight Orders
Section 8: List of Menus

SECTION 1: System Start-up & General Information

General Information

Input Commands. Commands the user should input are identified by all capital letters and bold print (e.g. **RETURN** for the return key or **ESC** for the escape key).

Simultaneous Commands. Many times the user will have to strike two keys simultaneously. For example, to display a menu, the user will have to strike the CTRL key and the F10 key simultaneously. When required, simultaneous commands are identified by the notation **KEY/KEY** (e.g. **CTRL/F10** would mean strike the CTRL and the F10 keys simultaneously).

Menu Option Execution. To execute a menu option, hit **RETURN** when the option is highlighted with bold colors. You may move from one menu option to another by using the arrow keys.

Notepad. A notepad capability has been included in this system for use by the scheduler to document system problems or proposed system enhancements. The notepad can and should also be used to take notes during the scheduling process (e.g. while in the middle of developing a schedule with the system, the Ops Superintendent comes in the office and says he wants to fly next Tuesday -- all you have to do is hit **ALT/F9** then **N**. You will automatically go to the notepad. Type in the note to yourself. When you are done, you can go back to where you were by hitting **ALT/DOWN ARROW**).

Saving Your Work. Anytime you would like to save you work (e.g. mission crew spreadsheet) hit **ALT/F10** and follow the system instructions. If you would like to close the window after saving you work, hit **ALT/END**.

Data Base. It is very important that the data base be located in window #1. If for some reason the data base is removed from window #1 (e.g. you accidentally close the data base window), you need to save any work that needs saving, then close all windows. After all windows have been closed, restart the decision aid by hitting **CTRL/F10** then **A**.

The same is true for the notepad. The notepad must be located in window #2 at all times.

Conditions for Menu Option Execution. Before executing any option from the main menu, ensure all windows except window #1 (data base) and window #2 (notepad) are closed.

System Start-up

After you have entered the ENABLE software package and the ENABLE main menu is displayed, you can enter the decision aid by typing:

CTRL/F10 then **A**

The system logo will appear on the screen as shown in Figure 1

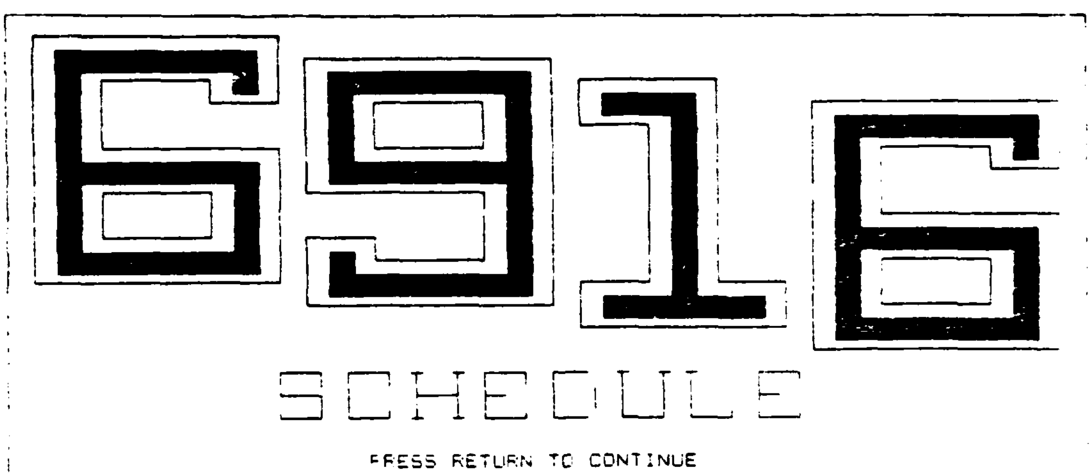


Figure B.1 System Logo

As instructed, hit **RETURN** to continue. The system will take a couple of minutes (if working on a hard drive computer) to open the data base and the notepad and will then display the MAIN MENU as shown is Figure B.2. If you would like to display the Main Menu while working with the decision aid (e.g. to move to another function), hit

CTRL/F10 then **A**

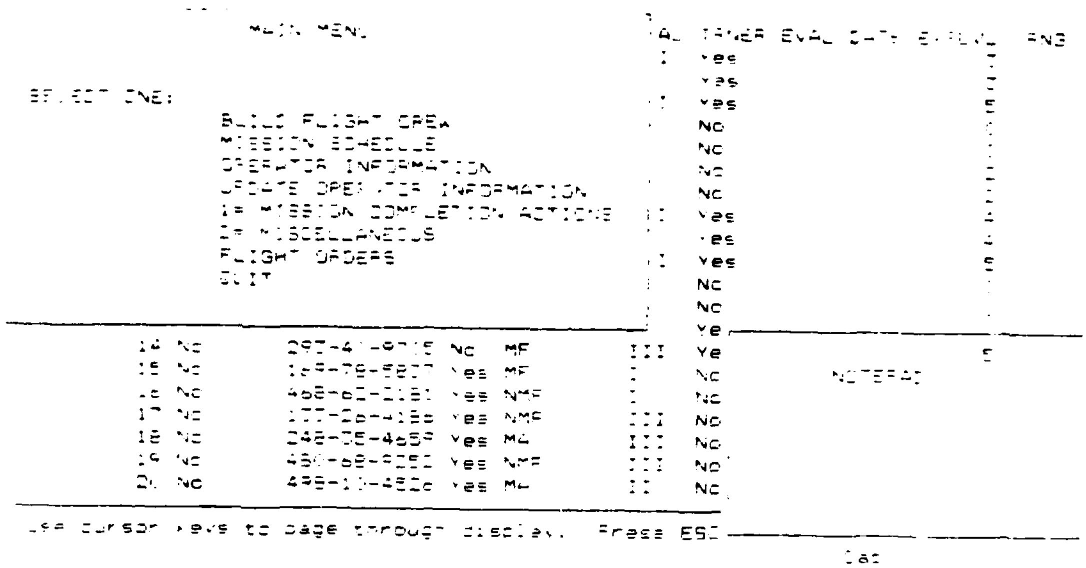


Figure B.2 Main Menu

SECTION 2: BUILD FLIGHT CREW

When the Main Menu is displayed, selection of the BUILD FLIGHT CREW OPTION will result in the BUILD FLIGHT CREW MENU to be displayed. This menu is shown in Figure B.3.

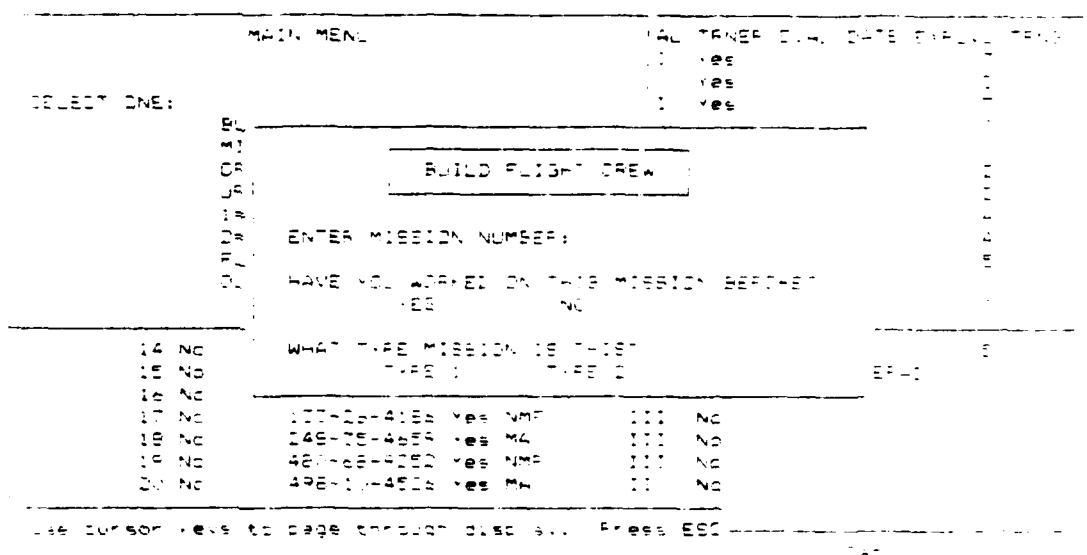


Figure B.3 Build Flight Crew Menu

Enter the mission number of the mission you would like to work on.

Next, answer the question have you worked on this mission before. If you answer yes, the system will go get the mission

crew spreadsheet that is stored in the system and will then display a menu asking you if you would like to display the mission crew or if you would like to select an operator. This [illegible] is shown in Figure B.4.

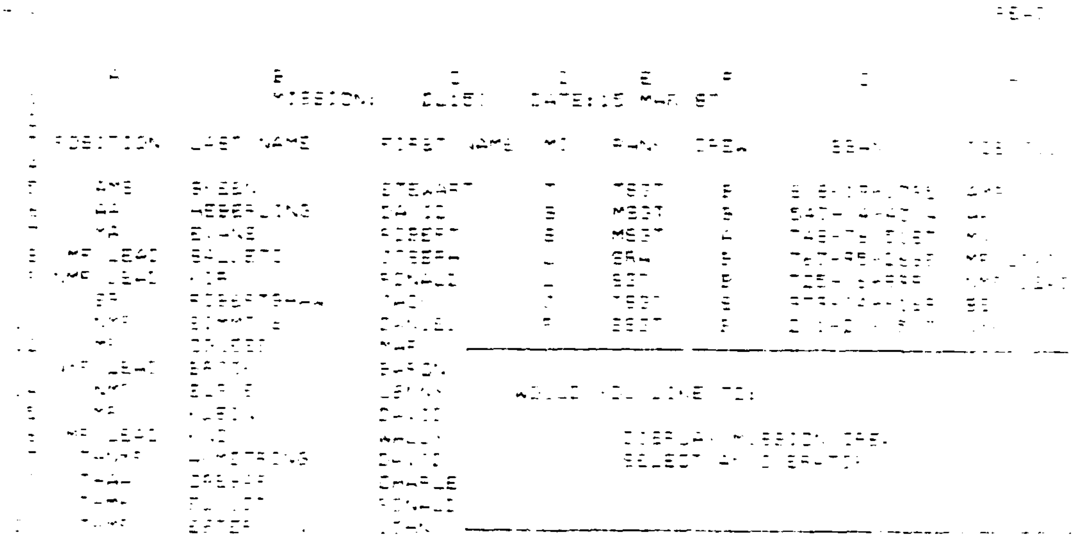


Figure B.4 Display Mission or Select Operator

If you select DISPLAY MISSION CREW the system will go to the mission crew spreadsheet. If after looking at the crew you would like to add an operator to the crew or replace a crewmember, hit

CTRL/F10 then A

This will display the operator selection menu.

If you choose SELECT AN OPERATOR, the system will display the operator selection menu shown in Figure B.5.

If you have not worked on a mission crew before, you will answer NO to question in the Build Flight Crew Menu. You will then be asked what type of mission is scheduled. Choose either TYPE 1 or TYPE 2.

After choosing the type of mission, the system will open a spreadsheet and set up the proper crew composition for the type of mission. Next, a menu will be displayed asking if you would like to hard schedule and operator (If you would like to hard schedule an operator anytime you are working on a mission, just hit **CTRL/F10 then E** and answer YES). This menu is shown in Figure B.6.

If you would like to hard schedule an operator answer YES and then type in the operator's last name. The system will take you to the data base where you must mark the operator with the F7 key in preparation of moving information from the data base to the mission spreadsheet (see Figure B.7). To mark an operator in the data base, put the cursor on the name of the operator then hit **F7**. Once the operator has been marked, go back to the

mission spreadsheet by hitting

F9 then W then 3 then G

((**NOTE:** this assumes you only have one mission crew spreadsheet open. If you have more than one open, hit **F9** then **W** then ? and choose the mission you want to schedule the operator for))

After you are back in the spreadsheet, put the cursor in the space to the right of the position you would like to schedule the operator for, then hit

ALT/F9 then S

Appropriate information about the operator will automatically be transferred from the data base to the mission crew spreadsheet as shown in Figure B.8.

```
                    SELECT OPERATOR TYPE

                ENTER DATE OF MISSION:   87,05,17
                                         (YY,MM,DD

 SELECT ONE:   AMS    1=AA    2=MA    SS    MF    NMF    MF    NMF
                   TRAINING QUEUE         QUIT

-----------------------------------------------------------------------
   SELECT ONE:       MF B/U                 1=MF LEAD
                     2=MF B/U TRAINEE       3=MF LEAD TRAINEE
                     4=MF B/U IRC           5=MF LEAD IRC
-----------------------------------------------------------------------
  SELECT CREW:    ABLE       BAKER      CHARLIE       DAYS
        1=ABLE & DAYS    2=BAKER & DAYS    3=CHARLIE & DAYS    4=ALL
-----------------------------------------------------------------------
                                                           Cap
```

Figure B.5 Operator Selection Menu

```
                                                                  READ

     A              B              C         D      E     F        G
                 MISSION:                 DATE:

  POSITION  LAST NAME      FIRST NAME  MI    RANK  CREW      SSAN

     AMS
      AA
   MF LEAD
   NMF LEAD
      ML
      SS
   NMF LEAD
     NMF
     NMF
      MF
      MF
   MF LEAD
    - AMS
    - AA
  - MF LEAD
   NMF LEAD
                         ------------------------------------------------
                         WOULD YOU LIKE TO HARD SCHEDULE AN OPT

                                 YES         NO

                          ENTER OPERATORS LASTNAME:
                                      >OFF
                         ------------------------------------------------
                                                           Cap
```

Figure B.6 Hard Scheduling an Operator

LAST NAME......	FIRST NAME......	MI	RANK	CREW	SSAN.........
[illegible]	THOMAS	J	SGT	A	392-56-7981
HOFF	THOMAS	J	SGT	A	392-56-7981

Use cursor keys to page through display. Press ESC when done.

[illegible] Marked POSITION Records ..170 Rc ..170 Sel ....2 [illegible]

Figure B.7 Data Base Example for Hard Scheduling

	A	B	C	D	E	F	G
1		MISSION:		DATE:			
2							
3	POSITION	LAST NAME	FIRST NAME	MI	RANK	CREW	SSAN
4							
5	AMS						
6	AA						
7	MF LEAD	HOFF	THOMAS	J	SGT	A	392-56-7981
8	NMF LEAD						
9	MA						
10	SS						
11	NMF LEAD						
12	NMF						
13	NMF						
14	MF						
15	MF						
16	MF LEAD						
17	T AMS						
18	T AA						
19	T MF LEAD						
20	T NMF LEAD						

Figure B.8 Mission Crew Spreadsheet after Hard Schedule

If you do not wish to hard schedule an op, choose NO and the system will take you to the operator selection menu shown in Figure B.5.

If you do not wish to select an operator, you can go directly to the mission crew spreadsheet by hitting

ESC

SECTION 3: MISSION SCHEDULE

The Mission Schedule Menu is shown in Figure B.9 below.

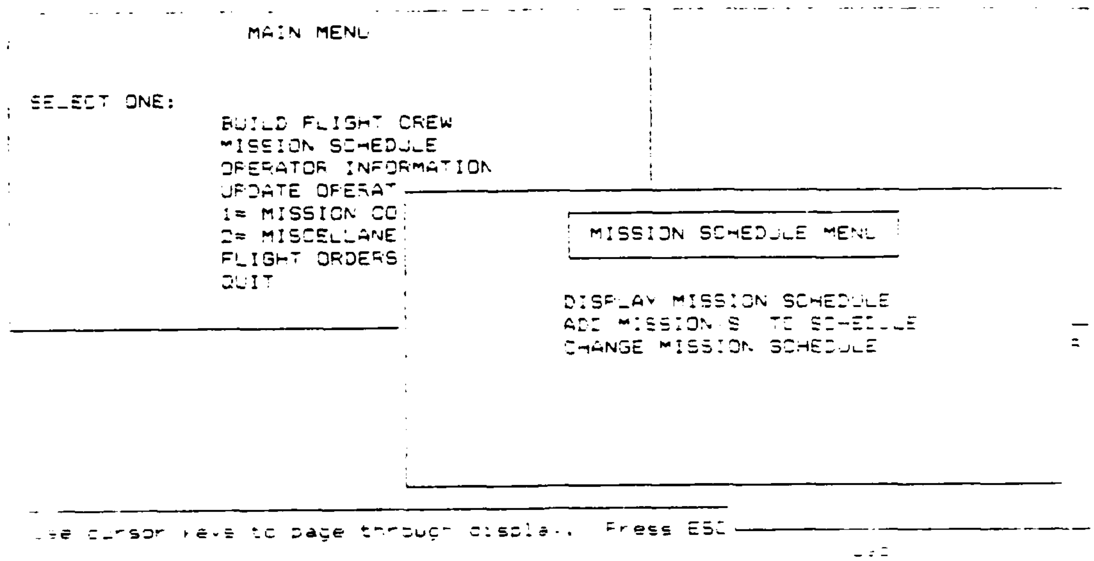


Figure B.9 Mission Schedule Menu

Choosing the DISPLAY MISSION SCHEDULE option produces a menu that asks for a start date for the missions. For example, if you would like to see all the missions scheduled after 2 Jan 87, you would input **87,01,02** as shown in Figure B.10. When entering the date, you must put it in **YY,MM,DD** format.

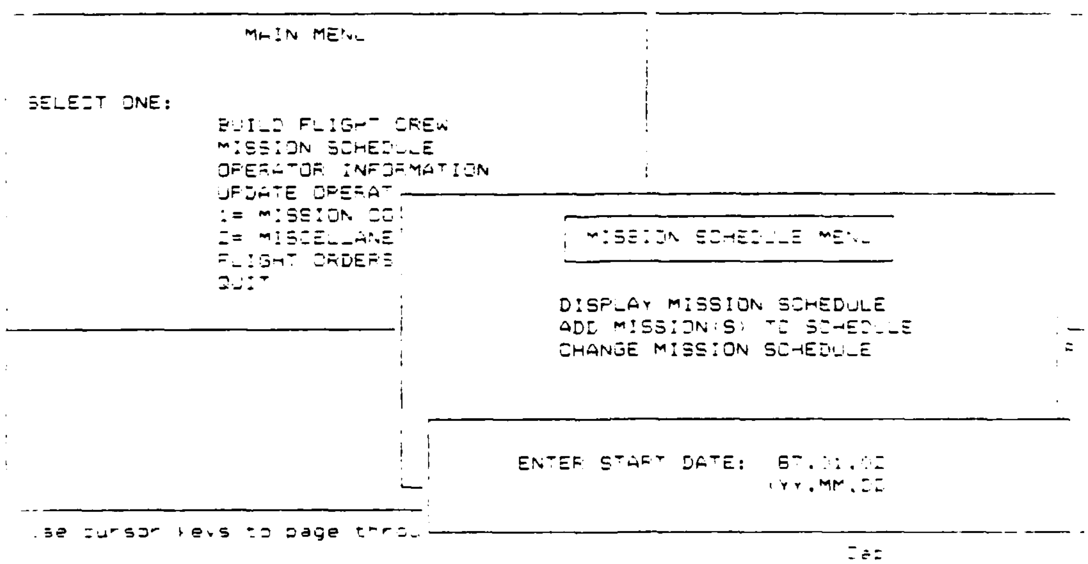


Figure B.10 Display Mission Schedule Option

If you would like to add a mission to the MISSION data base, choose the ADD MISSION(S) TO SCHEDULE option.

```
                  MAIN MEN        OPERATOR UPDATE MENU              ATE EXPL... TE

                              WOULD YOU LIKE TO:
SELECT ONE:                          ADD A RECORD
                BUILD FLIG           CHANGE A RECORD
                MISSION SC           DELETE A RECORD
                OPERATOR I
                UPDATE OPERATOR INFORMATION               No
                1= MISSION COMPLETION ACTIONS         I   Yes
                2= MISCELLANEOUS                          Yes
                FLIGHT ORDERS                         I   Yes
                QUIT                                      No
                                                          No
                                                          Yes
       14 No       293-40-9705 No   MF        III    Yes
       15 No       169-78-5877 Yes  MF        I      No
       16 No       468-62-2181 Yes  NMF       I      No
       17 No       133-26-4186 Yes  NMF       III    No
       18 No       248-35-4659 Yes  MA        III    No
       19 No       480-58-9252 Yes  NMR       III    No
       20 No       498-10-4526 Yes  MA        II     No

Use cursor keys to page through display.  Press ESC when done.
#.        POSITION        Records ..173 Rc ...20 Sel     20 DuDec
```

Figure B.11 Operator Update Menu

```
                  MAIN MEN |      OPERATOR UPDATE MENU        |ATE EXPLVL TEN
                           |                                  |
                           |  WOULD YOU LIKE TO:              |
 SELECT ONE:               |         ADD A RECORD             |

                          OPERATOR ADD MENU

        ENTER OPERATOR S LAST NAME:    KOPF

           AVAILABILITY
           1=ADD A NEW OPERATOR TO THE DATA BASE

   YOUR CHOICE WILL TAKE YOU TO THE APPROPRIATE DATA BASE.  TO ADD AN
   OPERATOR, SIMPLY TYPE IN THE APPROPRIATE INFORMATION AS IT IS
   REQUESTED. IF THIS IS A BRAND NEW OF AND YOU ARE SETTING UP NEW RECORDS,
   YOU WILL GO TO THE OPERATOR DATA BASE FIRST.  AFTER YOU ARE FINISHED
   ENTERING THE DATA, SAVE IT, THEN QUIT (F10 SAVE/QUIT).  CHOOSE ADD
   AGAIN BUT TYPE IN POSITION AT THE WHICH DATA BASE PROMPT, THEN HIT
   RETURN 3 TIMES.  YOU NOW MAY ENTER THE REST OF THE OPERATOR INFORMATION.

          POSITION        Records ..173 Rc ...20 Sel     20 DuDec
```

Figure B.12 Operator Add Menu

If you choose the CHANGE A RECORD option, the Operator Change Menu will be displayed on the screen. This menu is shown in Figure B.13. Again, if you follow the instructions given in the menu, you should have no problems. The instructions from the menu are repeated here for you.

Your choice will take you to the appropriate data base. To change a record (edit), simple mark the appropriate record using the F7 function key, press **ESC twice**, then press "E". The record can now be changed.
***** NOTE: If you change the SSAN, you must change it in all relations. *****

If you choose the DELETE A RECORD option, the Operator Delete Menu will be displayed as shown in Figure B.14. Again,

f... w the instructions ... instructions are repeated here

MAIN MENU | OPERATOR UPDATE MENU

WOULD YOU LIKE TO:
SELECT ONE: ADD A RECORD cursor

OPERATOR CHANGE MENU

ENTER OPERATOR S LASTNAME: KOPF

AVAILABILITY	QUALIFICATION
SSAN	TRAINER QUAL
NAME	1=TRAINEE PRIORITY
RANK	2=TRAINER STRENGTHS
CREW	EXPERIENCE LEVEL
OPERATOR TYPE	3=STAN/EVAL DATE
PRIMARY POSITION	

YOUR CHOICE WILL TAKE YOU TO THE APPROPRIATE DATA BASE. TO CHANGE A RECORD (EDIT), SIMPLY MARK THE APPROPRIATE RECORD USING THE F7 FUNCTION KEY. PRESS ESC TWICE, THEN PRESS "E". THE RECORD CAN NOW BE CHANGED.
**** NOTE, IF YOU CHANGE THE SSAN, YOU MUST CHANGE IT IN ALL RELATIONS

Esc

Figure B.13 Operator Change Menu

MAIN MENU | OPERATOR UPDATE MENU

WOULD YOU LIKE TO:
SELECT ONE: ADD A RECORD cursor

OPERATOR DELETE MENU

ENTER OPERATOR'S LASTNAME: KOPF

AVAILABILITY
1=ALL OPERATOR RECORDS

YOUR CHOICE WILL TAKE YOU TO THE APPROPRIATE DATA BASE. TO DELETE A RECORD: 1) MARK THE APPROPRIATE RECORD USING THE F7 FUNCTION KEY
2) PRESS "ESC" 2 TIMES
3) PRESS "1"
4) PRESS "RETURN" 2 TIMES
5) PRESS "ESC" 2 TIMES
6) PRESS "6"
7) PRESS "RETURN" 3 TIMES

OPERATOR Records ...(2) Rc ...(2) Sel ... Esc

Figure B.14 Operator Delete Menu

Your choice will take you to the appropriate data base. To delete a record:

1) Mark the appropriate record using the F7 function key
2) Press **ESC 2 times**
3) Press "1"
4) Press **RETURN 2 times**
5) Press **ESC 2 times**
6) Press "6"
7) Press **RETURN 3 times**

SECTION 6: MISSION COMPLETION ACTIONS

The Mission Completion Actions Menu is shown in Figure B.15. T   ll up this menu at any time type **CTRL/F10** then C.

```
                MAIN MENU
                                                     ter
   SELECT ONE:                                       w.  You may use cursor
                    BUILD FLIGHT CREW                c and press [—].
                    MISSION SCHEDULE                 he desired option.
                        MISSION COMPLETION MENU

              UPDATE MISSION HISTORY DATA BASE
              1=UPDATE OPERATOR FLIGHT HISTORY DATA BASE
              2=UPDATE 30/90 DAY FLIGHT HOUR TOTALS
                      30 DAY UPDATE
                      90 DAY UPDATE
              ADD INDIVIDUAL HOURS  ET-A,C-130,ETC.
              RETURN TO MAIN MENU

 Use this command to display selected records from a database.
 #1        OPERATOR        Records ..120 Rc ..120 Sel    .1 ..Dec
```

Figure B.15 Mission Completion Menu

If you choose the UPDATE MISSION HISTORY DATA BASE option, the system will ask you for the mission number and will then display the MISSION HISTORY UPDATE FORM as shown in Figure B.16. Just fill in the data. As shown in the menu, when you have completed all the information, press **F5** to save in the information in the data base. When finished, return to the Mission Completion Menu by typing **CTRL/F10** then C.

```
                     MISSION HISTORY UPDATE FORM

              MISSION:
              DATE:
              TAKEOFF:
              LAND:
              DURATION: 0.0
              ORBIT TIME: 0.0                   WHEN DONE, PRESS F5 TO
                                                SAVE
              WATCH TIME: 0.0
              STATUS:          PRIORITY: 0

        REMARKS:                                PRESS CTL F10 THEN C
                                                TO CONTINUE WHEN FINISHED
 A          MSNHISTY       Records .....7 Rc ..... Sel    .  ..Dec
```

Figure B.16 Mission History Data Base Input Form

If you choose the UPDATE OPERATOR FLIGHT HISTORY DATA BASE option, the system will ask you for the mission number. After you have provided the mission number the system will transfer data from the mission crew spreadsheet to the MSNDONE spreadsheet in preparation for updating the OPHISTY data base. The system will prompt you for the mission date -- input the date in YY.MM.DD format. Next the system will ask for the mission duration. After you have provided that information, the system automatically updates the data base and closes the spreadsheet windows.

If you choose the 30 DAY UPDATE option, the system will compute each operators 30 day flight hours (if they have flown in the past 30 days). If a mission has been completed execute the UPDATE OPERATOR FLIGHT HISTORY DATA BASE option before doing the 30 or 90 day flight hours. The system will ask you for the 30 day window with the prompt

Where : DATE GE

Enter the 30 day window (e.g. 30 days ago) in **YY.MM.DD** format (e.g. if today was 14 Apr 87, then the 30 day window would be input as

"87,03,14"

An example is shown in Figure B.17. It is very important that you put quotation marks (" ") around the date or the system will give you an error. Once you have give the system the 30 day window, the system will automatically compute each operator's 30 day flight hours and update the data base with the new numbers. This process may take several minutes to complete on a hard disk system (longer on a floppy only system) so do not get impatient. If for some reason the system is not working after a considerable amount of time, press **CTRL/BREAK**. If the system still does not work, power cycle and start over.

```
 Sort                    Database Management System

Database: C:\TKOPP\OPHISTY
Index    :
Where    : DATE GE "87,03,14"
Fields: (Enter each sort field followed by a comma and A or D)
 Field 1: SSAN                              Field 5:
 Field 2: DATE                              Field 6:
 Field 3:                                   Field 7:
 Field 4:                                   Field 8:
------------------------------------------------------------------
Operators are:
AND OR NOT      = = =         LT GT EQ LE GE NE     + - *   **      $ $-
------------------------------------------------------------------
Fields are:

 S:S:RECORD   DELETED     SSAN        MISSION      DURATION
 POSITION     DATE        LASTNAME    FIRSTNAME


 Press PgDn to select from above
 Releasing selected records to sort procedure.
        OPHISTY         Records ..156 Fd ..125 Sel ..... Cur .....
```

ure B.17 30 Day Window Prompt for 30 Day Flight H

The 90 DAY UPDATE option works much the same way as the 30

DAY UPDATE option works. The system will prompt you for the 90 day window in the same way it asked for the 30 day window. Once you have given the system the 90 day window, the system will automatically calculate the 90 day hours and update the data base. For more information, read the section on the 30 DAY UPDATE option above.

The ADD INDIVIDUAL HOURS option will display the Operator Flight Hour Input Form. This option should be used when an operator accumulates flight hours on aircraft or missions other than those flown from the 6916th. The input form is shown in Figure B.18. The form is pretty self explanatory -- just fill in the data it asks for. The POSITION item does not need to be filled in nor does the MISSION NUMBER item.

```
                 : OPERATOR FLIGHT HOUR INPUT FORM :

     OPERATOR S SSAN:

     FLIGHT DATE:

     MISSION NUMBER:

     FLIGHT TIME: 0.0

     POSITION:



     OPHISTY        Records ..166 Rd ....0 Sel ....0 CuCac
```

Figure B.18 Operator Flight Hour Input Form

SECTION 6: MISCELLANEOUS

The Miscellaneous Menu is shown in Figure B.19. This function was designed to allow the scheduler to keep track of who requires recurring training. All four menu options take you to the OPERATOR data base and allow you to input your own 'WHERE' specifications. For example, if you were interested in who needed physiological refresher training in the next 6 months so you could make TDY arrangements well in advance, at the WHERE prompt you would type

PHYSIO LT '81,11,03'

((This assumes that physiological refresher is every 6 years and that 'todays' date is 3 Apr 87))

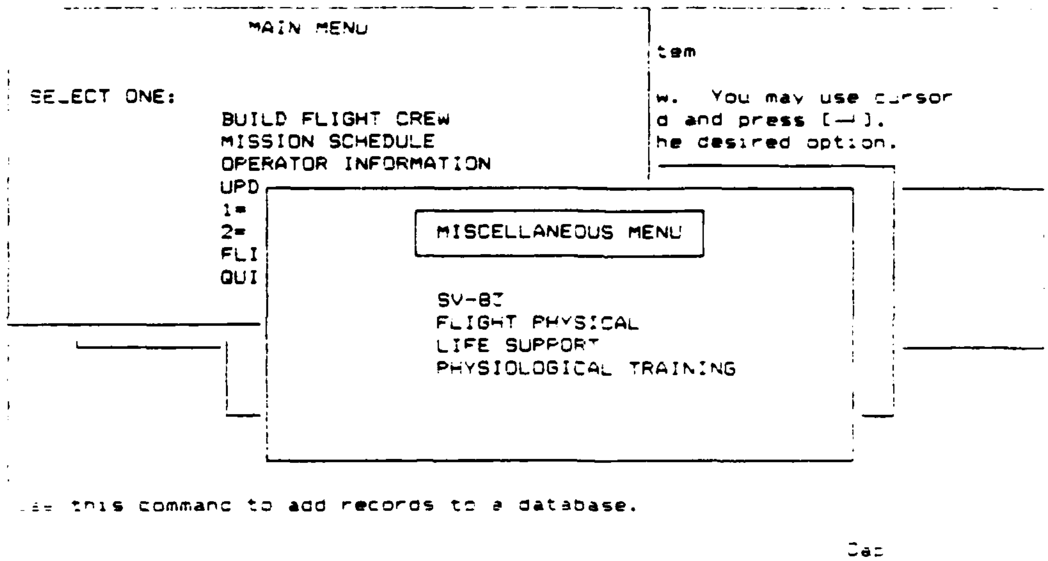


Figure B.19 Miscellaneous Menu

SECTION 7: FLIGHT ORDERS

he Flight Orders Menu is shown in Figure B.20.

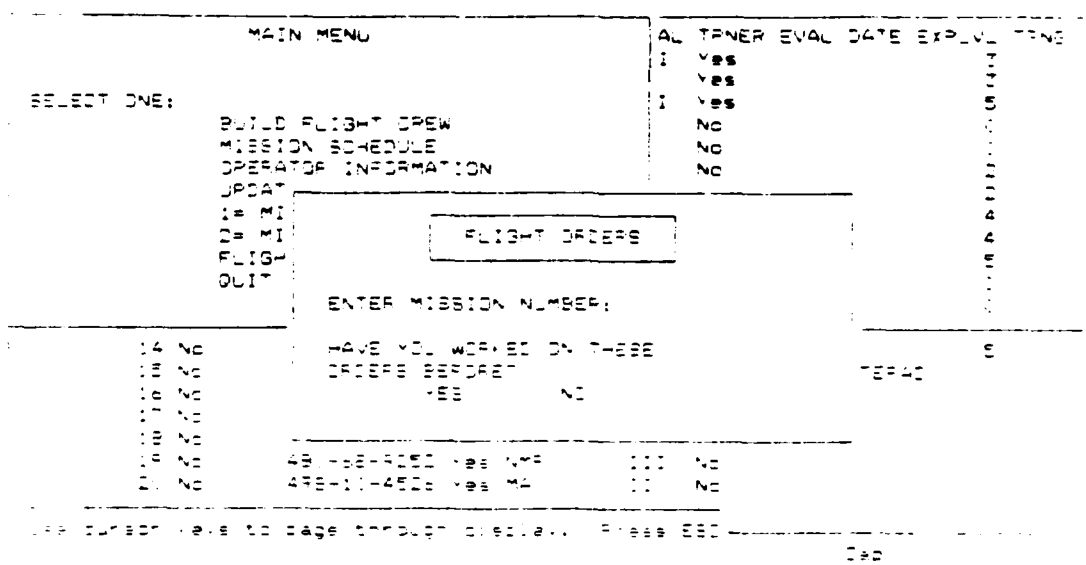


Figure B.20 Flight Orders Menu

As you can see, the system asks you which mission you would like to work on orders for. After you enter the mission number, answer the question on whether you have worked on these orders before.

Have Not Worked on This Mission's Flight Orders Yet. If you have not worked on these orders yet, answer NO to the question.

The system will automatically open a word processing document for you. The system will automatically prompt you for all the information it can not get from the mission crew spreadsheet.

The system will first ask you for the expected land date. Next, you will be asked for the date and takeoff time. A display of this prompt is shown in Figure B.21. In the background, you can see the expected land date was inserted in the upper right hand corner. The date in the upper left hand corner was transferred from the mission crew spreadsheet. The [illegible] information displayed in Figure B.21 was inserted by [illegible] flight orders program.

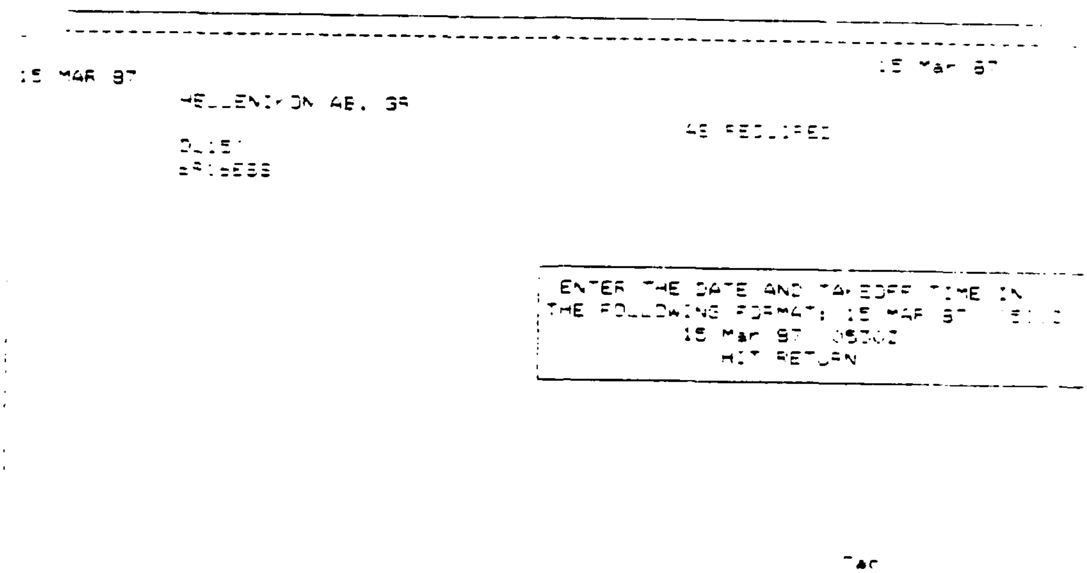


Figure B.21 Date and Take Off Time Prompt

Next, the system will asked you for today's date, and then it will ask for the order number.

The system has now completed the flight orders and asks you if you would like to examine the orders or make changes. This is shown in Figure B.22.

If you do not wish to examine the orders answer NO and the system will display the Flight Orders Print Menu shown in Figure B.22. If you would like to print the orders, the system will ask you to insert the orders into the printer and and hit return. If you would not like to print the orders, the system will ask you if you want to make any changes.

If you want to examine the orders, answer YES. The system will send you to the flight orders word processing file where you can examine the flight orders before you type them. When finished looking at the orders type

CTRL/F10 then **K**

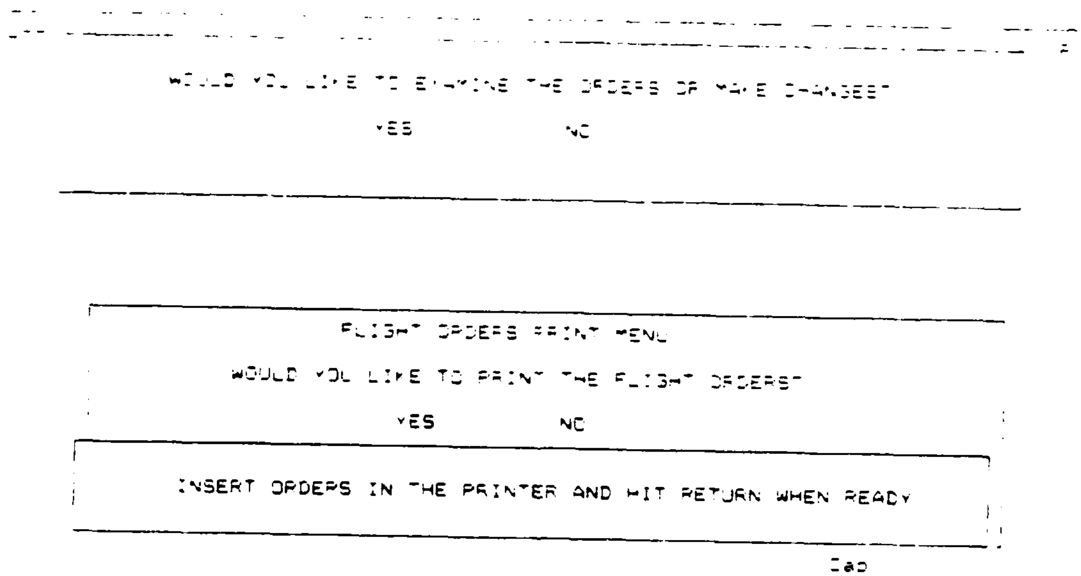


Figure B.22 Flight Orders Print Menu

SECTION 8: LIST OF MENUS

Table B.1 contains a list of menus you may call while working with the decision aid. To display any of the menus hit

CTRL/F10

followed by the letter designator listed below.

Table B.1 List of Menus

Letter Designation	Title
A	System Logo
B	Build Flight Crew Menu
C	Mission Completion Menu
N	Main Menu
E	Hard Schedule an Operator Menu
2	Operator Selection Menu
S	Mission Schedule Menu
U	Operator Update Menu
F	Flight Orders Menu
K	Flight Orders Change/Print Menu

APPENDIX C

MAINTAINER'S MANUAL

For

6916th Electronic Security Squadron's

Scheduling

Decision Aid

This manual is designed for the maintainer of the 6916ESS Scheduling Decision Aid and is to be used in conjuction with the ENABLE documentation. The manual is incorporated in Appendix format to allow for extraction as a stand-alone document. Additional information about this decision aid can be found in Appendix B (User's Guide).

MAINTAINER'S MANUAL

This manual is written for the individual responsible for maintaining the 6916ESS scheduling decision aid. The maintainer should have a good working knowledge of the capabilities of ENABLE. This manual is divided into four sections: spreadsheets, data base, menus, and macro procedures.

Section 1. SPREADSHEET MAINTENANCE. The spreadsheets used or created in the 6916ESS scheduling decision aid and their purpose are listed in Table C.1.

Table C.1 Spreadsheets

NAME	PURPOSE
THIRTY	Used during calculation of 30 day flight hours. This spreadsheet holds the data to update the data base.
NINETY	Used during calculation of 90 day flight hours. This spreadsheet holds the date to update the data base.
LLNNN	These are the mission crew spreadsheets where LL stands for 2 letters and NNN stands for 3 numbers (e.g DL150). Contains the crewmembers names, positions, and other data for each mission crew.
TYPE1	Profile for position configuration for Type 1 missions.
TYPE2	Profile for position configuration for Type 2 missions.
HOURS3	Used to calculate the 30 day flight hours
HOURS9	Used to calculate the 90 day flight hours
ORDERS	Used to transfer crewmember's names and SSANs from the mission crew spreadsheet to a word processing file for flight orders preparation.
WORKSKED	Contains the rotating work schedule for each crew.
MSNDONE	Used to transfer operator information from a mission crew spreadsheet to the OPHISTY data base relation.

Section 2. DATA BASE MAINTENANCE. The 6916ESS scheduling decision aid uses 6 data relations. A detailed discussion of each relation is located in Chapter IV. The Tables defining each relation in Chapter IV are reproduced in this manual for easier use by the maintainer. Maintenance of the data within each data relation is handled from within the decision aid itself. For more information see Appendix B.

Table 4.3 ABSENT.DBF Relation

Field Name	Description	Purpose
SSAN	Operator's Social Number	Allows scheduler to link to other data relations
START	Date Operator becomes Unavailable	Used during searches for available operators
STOP	Date Operator becomes Available	Used during searches for available operators
REASON	Reason Operator is Unavailable	Used to answer queries why an operator is unavailable

The following field names access data from the OPERATOR relation: (see Table 4.1)

LASTNAME, FIRSTNAME

Table 4.1 OPERATOR.DBF Data Relation

FIELD NAME	DESCRIPTION	PURPOSE
SSAN	Operator's Social Security Number	Used as a unique identification number which allows integration of several relations
LASTNAME	Operator's Last Name	Used by the scheduler as the primary means of identifying an operator
FIRSTNAME	Operator's First Name	Used in conjunction with an operator's last name
MI	Operator's Middle Initial	Used in conjunction with first and last names
RANK	Operator's Rank	Used for Flight Orders and crew balance
TYPE	Operator's General Type	Used for general data base searches for squadron management
CREW	Operator's Work Crew (Able, Baker, Charlie, Days)	Used for data base searches to identify operators for a mission
THIRTY	Number of Flight Hours an Operator has over the past 30 days	Used to insure an operadoes not exceed AF limits for 30 day hours
NINETY	Number of Flight Hours an Operator has over the past 90 days	Same as THIRTY except for 90 consecutive days instead of 30
SV83	Date Operator last attended SV-83 training	Used to schedule operators for SV-83 training
LIFESPT	Date Operator last attended Life Support Training	Used to schedule operators for semi-annual life support training
PHYSIO	Date Operator last attended Physiological Training	Used to schedule operators for recurring physiological training
FLTPHYS	Date Operator last had a Flight Physical	Used to monitor complicwith annual flight physical requirement

Table 4.2 POSITION.DBF Relation

Field Name	Description	Purpose
SSAN	Operator's Social Security Number	Unique identifier which allows access to other relations
POSITION	Position Designation	Desgnation for each position an op is qualified for or is in training for
PRIMARY	Yes/No field	Flag for an op's primary position
QUAL	Position Qualification Level	Designator for the qualification level an op has reached for a position
TRAINER	Yes/No field	Flag to designate if an op is a qualified trainer
EVAL	Evaluation Date	Date an op is due an evaluation for a position
EXPLEVEL	Experience Designation	Subjective measurement of an op's experience in a position -- Assigned by squadron management -- Defined for future model applications
TRNGQUE	Training Priority	Subjective priority given to trainees -- Assigned by squadron management.
STRENGTH	Strength as a Trainer	Used to help match trainees with trainers
WEAKNESS	Weakness as a Trainee	Used to help match trainees with trainers

The following fields access information from the OPERATOR relation: (see Table 4.1)

LASTNAME, FIRSTNAME, MI, RANK, CREW, THIRTY, AND, NINETY

The following fields access information from the ABSENT relation: (see Table 4.3)

START, STOP, AND REASON

Table 4.4 OPHISTY.DBF Relation

Field Name	Description	Purpose
SSAN	Operator's Social Security Number	Used to access information from other data relations
MISSION	Mission Number Designation	Used to access information from another relation
DURATION	Mission Duration in hours	Used to calculate 30/90 day flight hours
POSITION	Position Designator	Used to designate which position op flew
DATE	Mission Date	Used to when calculating 30/90 day flight hours

The following field names access information from the OPERATOR relation: (see Table 4.1)

LASTNAME, FIRSTNAME

Table 4.5 MSNHISTY.DBF Relation

Field Name	Description	Purpose
MISSION	Mission Number Designator	Unique identifier for each mission
DATE	Mission Date	Date mission was flown
TAKEOFF	Take Off Time	Take off time helps determine mission duration
LAND	Land Time	Land time helps determine mission duration
DURATION	Mission Duration	Used when determining total hours flown by the squadron
ORBITTIME	Mission Orbit Time	Total time on orbit helps determine mission effectiveness
WATCHTIME	Mission Watch Time	Total watch time helps determine mission effectiveness
STATUS	Mission Status	Determined by planned vs actual orbit time -- a measure of effectiveness
REMARKS	Mission Remarks	Used to add general remarks about a mission
PRIORITY	Mission Priority	Used to highlight missions that required special attention when scheduling the mission crew

Table 4.6 MISSION.DBF Relation

Field Name	Description	Purpose
TYPE	Mission Type	Determines position configuration
NUMBER	Mission Number	Unique identification for each mission
TAKEOFF	Take Off Time	Scheduled takeoff time helps determine crewrest violations
LAND	Land Time	Scheduled land time helps determine crewrest violations
DATE	Mission Date	Scheduled mission date determines which crew is responsible for mission manning
SHOWTIME	Pre-mission Show Time	Scheduled crew showtime determined by scheduled takeoff time
PRIORITY	Mission Priority	Designator for missions that require special attention when scheduling crewmembers
DURATION	Mission Duration	Scheduled mission duration determined by scheduled takeoff and land times

Section 3. MENU MAINTENANCE. The menu system developed for the 6916ESS scheduling decision aid controls the actions of the decision aid and also allows the user to work on his own. For each menu option the system response will either be to go to another menu or to execute a macro procedure. The format for the remainder of this section will be to give the menu name, then a replica of the menu, and finally the system action for each of the menu choices.

MENU A: (Logo)

1. Option RETURN

   Action: Macro Code

```
{VOFF}              ;; Turn video off
{&HOME}             ;; Open a window
U                   ;; Use the system
D                   ;; Go to the data base
I                   ;; Interact with the data base
D POSITION          ;; Display POSITION.DBF relation
~~~~                ;; 4 Returns
{&HOME}             ;; Open a window
U W                 ;; Use the Word Processing program
R NOTEPAD           ;; Revise WP file NOTEPAD.WPF
~                   ;; Return
{&F9}S              ;; Call WP macro procedure S
{VON}               ;; Turn video back on
{^F10}N             ;; Call Menu N (Main Menu)
```

MENU N: (Main Menu)

```
                         MAIN MENU

SELECT ONE:
                      BUILD FLIGHT CREW
                      MISSION SCHEDULE
                      OPERATOR INFORMATION
                      UPDATE OPERATOR INFORMATION
                      1= MISSION COMPLETION ACTIONS
                      2= MISCELLANEOUS
                      FLIGHT ORDERS
                      QUIT
```

1. Option BUILD FLIGHT CREW
   Action: Go to Menu B

2. Option MISSION SCHEDULE
   Action: Go to Menu S

3. Option OPERATOR INFORMATION
   Action: Macro Code

```
{F9}W1G          ;; Go to Window #1 (data base window)
{ESC} {ESC}      ;; Go to the data base actions menu
D POSITION       ;; Display POSITION relation
{15X}{DEL}       ;; 15 deletes to delete an unwanted
                    characters
```

4. Option UPDATE OPERATOR INFORMATION
   Action: Go to Menu U

5. Option MISSION COMPLETION ACTIONS
   Action: Go to Menu C

6. Option MISCELLANEOUS
   Action: Go to Menu MISC

7. Option FLIGHT ORDERS
   Action: Go to Menu F

8. Option QUIT
   Action: Go to Menu QUIT

MENU B: (Build Flight Crew)

```
                    BUILD FLIGHT CREW

        ENTER MISSION NUMBER: ______

        HAVE YOU WORKED ON THIS MISSION BEFORE?
              YES          NO

        WHAT TYPE MISSION IS THIS?
             TYPE 1      TYPE 2
```

1. Option ENTER MISSION NUMBER
   Action: Puts the mission number in memory for later use
   Goes to YES field

2. Option YES
   Action: Macro Code

```
{&HOME}            ;; Open window
US                 ;; Use spreadsheet application
R [%MISSION]       ;; Revise mission crew spreadsheet for
                   ;; appropriate mission (entered in
                   ;; option 1)
~                  ;; Return
{F2}A1~            ;; Go to space A1 in the spreadsheet
                   ;; and Return
{^F10}D            ;; Go to Menu D
```

3. Option NO
   Action: Go to TYPE 1 field

4. Option TYPE 1
   Action: Macro Code (creates a mission type 1 spreadsheet)

```
{&HOME}            ;; Open window
US                 ;; Use spreadsheet application
C [%MISSION]       ;; Create a mission crew spreadsheet
{&F9}3             ;; Call SS Macro procedure 3
{^F10}E            ;; Go to Menu E
```

5. Option TYPE 2
   Action: Macro Code (creates a mission type 2 spreadsheet)

```
{&HOME}            ;; Open window
US                 ;; Use spreadsheet application
C [%MISSION]       ;; Create a mission crew spreadsheet
{&F9}2             ;; Call SS Macro procedure 3
{^F10}E            ;; Go to Menu E
```

MENU E:

WOULD YOU LIKE TO HARD SCHEDULE AN OP?

YES NO

ENTER OPERATORS LASTNAME: ______________________

1. Option YES
   Action: Go to option ENTER OPERATORS LASTNAME

2. Option NO
   Action: Go to Menu D

3. Option ENTER OPERATORS LASTNAME
   Action: Macro Code

```
{F9}W1G             ;; Go to window #1 (data base)
{ESC}{ESC}          ;; Go to data base actions menu
D POSITION          ;; Display POSITION relation
{15X}{DEL}          ;; Delete unwanted characters
~~                  ;; 2 Returns
LASTNAME = "[%LASTNAME]"~  ;; Specification for data
                              base search
LASTNAME,FIRSTNAME,MI,RANK,CREW,SSAN  ;; Definition of
                                         data fields
                                         to display
~                   ;; Return
```

MENU D:

WOULD YOU LIKE TO:

DISPLAY MISSION CREW
SELECT AN OPERATOR

1. Option DISPLAY MISSION CREW
   Action: Macro Code

```
{F9}W3G             ;; Go to window #3 (mission crew
                       spreadsheet)
```

2. Option SELECT AN OPERATOR
   Action: Go to Menu 2

MENU 2:

SELECT OPERATOR TYPE

ENTER MISSION DATE: ___________
(YY,MM,DD)

SELECT ONE: AMS 1=AA 2=MA SS MF NMF MR NMR
TRAINING QUEUE QUIT

1. Option ENTER MISSION DATE
   Action: Mission date used to determine op availability
   Go to AMS option

2. Option AMS
   Action: Go to Menu AMS

3. Option AA
   Action: Go to Menu AA

4. Option MA
   Action: Go to Menu MA

5. Option SS
   Action: Go to Menu SP

6. Option MF
   Action: Go to Menu MF

7. Option NMF
   Action: Go to Menu NMF

8. Option MR
   Action: Go to Menu MR

9. Option NMR
   Action: Go to Menu NMR

10. Option TRAINING QUEUE
    Action: Macro Code

```
{VOFF}                    ;; Turn the video off
{F9}WIG                   ;; Go to window #1 (data base)
{ESC}{ESC}                ;; Go to data base actions menu
S C:\TKOPF\POSITION       ;; Sort POSITION relation
~~                        ;; 2 Returns
{75X}{DEL}                ;; Delete unwanted characters
TRNGQUE NE 0              ;; Specification for data base
                             search
~                         ;; Return
TRNGQUE.A                 ;; First sort field, ascending
                             order
~                         ;; Return
```

```
CREW.A                     ;; Second sort field, ascending
                              order
~                          ;; Return
POSITION.A                 ;; Third sort field, ascending
                              order
~~                         ;; 2 Returns
{ESC}                      ;; Go to data base actions menu
D                          ;; Display sorted list
~~                         ;; 2 Returns
{75X}{DEL}                 ;; Delete unwanted characters
LASTNAME{{}14{}},          ;; Fields to display
FIRSTNAME{{}11{}},
CREW{{}5{}},
POSITION {{}9{}},
TRNGQUE{{}7{}}
~                          ;; Return
{VON}                      ;; Turn video back on
```

11. Option QUIT
    Action: Go to Menu QUIT

MENU AMS:

SELECT ONE: AMS 1=AMS TRAINEE 2=AMS IRO

1. Option AMS
   Action: Go to Menu AMSCREW

2. Option AMS TRAINEE
   Action: Go to Menu AMSTCREW

3. Option AMS IRO
   Action: Go to Menu AMSICREW

MENU AA:

SELECT ONE: AA 1=AA TRAINEE 2=AA IRO

1. Option AA
   Action: Go to Menu AACREW

2. Option AA TRAINEE
   Action: Go to Menu AATCREW

3. Option AA IRO
   Action: Go to Menu AAICREW

MENU MA:

SELECT ONE: MA 1=MA TRAINEE 2=MA IRO

1. Option MA
   Action: Go to Menu MACREW

2. Option MA TRAINEE
   Action: Go to Menu MATCREW

3. Option MA IRO
   Action: Go to Menu MAICREW

MENU SP:

SELECT ONE: SS 1=SS TRAINEE 2=SS IRO

1. Option SS
   Action: Macro Code

```
{VOFF}                  ;; Turn video off
{F9}W1G                 ;; Go to window #1 (data base)
{&F9}D                  ;; Call DB macro procedure D
POSITION = 'SS'         ;; Specification for which type of
                           ops to display
{&F9}O                  ;; Call DB macro procedure O
~                       ;; Return
{&F9}P                  ;; Call DB macro procedure P
{VON}                   ;; Turn video on
```

2. Option SS TRAINEE
   Action: Macro Code

```
{VOFF}                  ;; Turn video off
{F9}W1G                 ;; Go to window #1 (data base)
{&F9}D                  ;; Call DB macro procedure D
POSITION = 'SS' AND     ;; Specification for which type of
                           ops to display
EXPLEVEL = 0
{&F9}O                  ;; Call DB macro procedure O
~                       ;; Return
{&F9}P                  ;; Call DB macro procedure P
{VON}                   ;; Turn video on
```

3. Option SS IRO
   Action: Macro Code

```
{VOFF}                  ;; Turn video off
{F9}W1G                 ;; Go to window #1 (data base)
{&F9}D                  ;; Call DB macro procedure D
POSITION = 'SS' AND     ;; Specification for which type of
```

```
                                        ops to display
        TRAINER = YES
        {&F9}O                    ;; Call DB macro procedure O
        ~                         ;; Return
        {&F9}P                    ;; Call DB macro procedure Q
        {VON}                     ;; Turn video on
```

MENU MF:

SELECT ONE:	MF B/U	1=MF LEAD
	2=MF B/U TRAINEE	3=MF LEAD TRAINEE
	4=MF B/U IRO	5=MF LEAD IRO

1. Option MF B/U
   Action: Go to Menu MFBCREW

2. Option MF B/U TRAINEE
   Action: Go to Menu MFBTCREW

3. Option MF B/U IRO
   Action: Go to Menu MFBICREW

4. Option MF LEAD
   Action: Go to Menu MFLCREW

5. Option MF LEAD TRAINEE
   Action: Go to Menu MFLTCREW

6. Option MF LEAD IRO
   Action: Go to Menu MFLICREW

MENU NMF:

SELECT ONE:	NMF B/U	1=NMF LEAD
	2=NMF B/U TRAINEE	3=NMF LEAD TRAINEE
	4=NMF B/U IRO	5=NMF LEAD IRO

1. Option NMF B/U
   Action: Go to Menu NMFBCREW

2. Option NMF B/U TRAINEE
   Action: Go to Menu NMFBTCRE

3. Option NMF B/U IRO
   Action: Go to Menu NMFBICRE

4. Option NMF LEAD
   Action: Go to Menu NMFLCREW

5. Option NMF LEAD TRAINEE
   Action: Go to Menu NMFLTCRE

6. Option NMF LEAD IRO
   Action: Go to Menu NMFLICRE

MENU MR:

SELECT ONE:	MR B/U	1=MR LEAD
	2=MR B/U TRAINEE	3=MR LEAD TRAINEE
	4=MR B/U IRO	5=MR LEAD IRO

1. Option MR B/U
   Action: Go to Menu MRBCREW

2. Option MR B/U TRAINEE
   Action: Go to Menu MRBTCREW

3. Option MR B/U IRO
   Action: Go to Menu MRBICREW

4. Option MR LEAD
   Action: Go to Menu MRLCREW

5. Option MR LEAD TRAINEE
   Action: Go to Menu MRLTCREW

6. Option MR LEAD IRO
   Action: Go to Menu MRLICREW

MENU NMR:

SELECT ONE:	NMR B/U	1=NMR LEAD
	2=NMR B/U TRAINEE	3=NMR LEAD TRAINEE
	4=NMR B/U IRO	5=NMR LEAD IRO

1. Option NMR B/U
   Action: Go to Menu NMRBCREW

2. Option NMR B/U TRAINEE
   Action: Go to Menu NMRBTCRE

3. Option NMR B/U IRO
   Action: Go to Menu NMRBICRE

4. Option NMR LEAD
   Action: Go to Menu NMRLCREW

5. Option NMR LEAD TRAINEE
   Action: Go to Menu NMRLTCRE

6. Option NMR LEAD IRO
   Action: Go to Menu NMRLICRE

MENU AMSCREW:

```
SELECT CREW:  ABLE       BAKER       CHARLIE       DAYS
      1=ABLE & DAYS   2=BAKER & DAYS   3=CHARLIE & DAYS   4=ALL
```

1. Option ABLE
   Action: Macro Code

```
{VOFF}                       ;; Turn video off
{F9}W1G                      ;; Go to window #1 (data base)
{&F9}D                       ;; Call DB macro procedure D
POSITION = 'AMS' AND ;; Data base display specification
CREW = 'A'
{&F9}O                       ;; Call DB macro procedure O
~                            ;; Return
{&F9}P                       ;; Call DB macro procdure P
{VON}                        ;; Turn video back on
```

2. Option BAKER
   Action: Macro Code

```
{VOFF}                       ;; Turn video off
{F9}W1G                      ;; Go to window #1 (data base)
{&F9}D                       ;; Call DB macro procedure D
POSITION = 'AMS' AND ;; Data base display specification
CREW = 'B'
{&F9}O                       ;; Call DB macro procedure O
~                            ;; Return
{&F9}P                       ;; Call DB macro procdure P
{VON}                        ;; Turn video back on
```

3. Option CHARLIE
   Action: Macro Code

```
{VOFF}                       ;; Turn video off
{F9}W1G                      ;; Go to window #1 (data base)
{&F9}D                       ;; Call DB macro procedure D
POSITION = 'AMS' AND ;; Data base display specification
CREW = 'C'
{&F9}O                       ;; Call DB macro procedure O
~                            ;; Return
{&F9}P                       ;; Call DB macro procdure P
{VON}                        ;; Turn video back on
```

4. Option DAYS
   Action: Macro Code

```
{VOFF}                       ;; Turn video off
{F9}W1G                      ;; Go to window #1 (data base)
{&F9}D                       ;; Call DB macro procedure D
POSITION = 'AMS' AND ;; Data base display specification
CREW = 'D'
{&F9}O                       ;; Call DB macro procedure O
~                            ;; Return
{&F9}P                       ;; Call DB macro procdure P
```

```
{VON}                       ;; Turn video back on
```

5. Option ABLE & DAYS
   Action: Macro Code

```
{VOFF}                      ;; Turn video off
{F9}W1G                     ;; Go to window #1 (data base)
{&F9}D                      ;; Call DB macro procedure D
POSITION = 'AMS' AND ;; Data base display specification
(CREW = 'A' OR
CREW = 'D')
{&F9}O                      ;; Call DB macro procedure O
~                           ;; Return
{&F9}P                      ;; Call DB macro procdure P
{VON}                       ;; Turn video back on
```

6. Option BAKER & DAYS
   Action: Macro Code

```
{VOFF}                      ;; Turn video off
{F9}W1G                     ;; Go to window #1 (data base)
{&F9}D                      ;; Call DB macro procedure D
POSITION = 'AMS' AND ;; Data base display specification
(CREW = 'B' OR
 CREW = 'D')
{&F9}O                      ;; Call DB macro procedure O
~                           ;; Return
{&F9}P                      ;; Call DB macro procdure P
{VON}                       ;; Turn video back on
```

7. Option CHARLIE & DAYS
   Action: Macro Code

```
{VOFF}                      ;; Turn video off
{F9}W1G                     ;; Go to window #1 (data base)
{&F9}D                      ;; Call DB macro procedure D
POSITION = 'AMS' AND ;; Data base display specification
(CREW = 'C' OR
 CREW = 'D')
{&F9}O                      ;; Call DB macro procedure O
~                           ;; Return
{&F9}P                      ;; Call DB macro procdure P
{VON}                       ;; Turn video back on
```

8. Option ALL
   Action: Macro Code

```
{VOFF}                      ;; Turn video off
{F9}W1G                     ;; Go to window #1 (data base)
{&F9}D                      ;; Call DB macro procedure D
POSITION = 'AMS' AND ;; Data base display specification
{&F9}O                      ;; Call DB macro procedure O
~                           ;; Return
{&F9}P                      ;; Call DB macro procdure P
{VON}                       ;; Turn video back on
```

MENU AMSICREW:

```
SELECT CREW:  ABLE      BAKER      CHARLIE      DAYS
      1=ABLE & DAYS   2=BAKER & DAYS   3=CHARLIE & DAYS   4=ALL
```

1. Option ABLE
   Action: Macro Code

```
{VOFF}                    ;; Turn video off
{F9}W1G                   ;; Go to window #1 (data base)
{&F9}D                    ;; Call DB macro procedure D
POSITION = 'AMS' AND ;; Data base display specification
CREW = 'A' AND
TRAINER = YES
{&F9}O                    ;; Call DB macro procedure O
~                         ;; Return
{&F9}P                    ;; Call DB macro procedure Q
{VON}                     ;; Turn video back on
```

2. Option BAKER
   Action: Macro Code

```
{VOFF}                    ;; Turn video off
{F9}W1G                   ;; Go to window #1 (data base)
{&F9}D                    ;; Call DB macro procedure D
POSITION = 'AMS' AND ;; Data base display specification
CREW = 'B' AND
TRAINER = YES
{&F9}O                    ;; Call DB macro procedure O
~                         ;; Return
{&F9}P                    ;; Call DB macro procedure Q
{VON}                     ;; Turn video back on
```

3. Option CHARLIE
   Action: Macro Code

```
{VOFF}                    ;; Turn video off
{F9}W1G                   ;; Go to window #1 (data base)
{&F9}D                    ;; Call DB macro procedure D
POSITION = 'AMS' AND ;; Data base display specification
CREW = 'C' AND
TRAINER = YES
{&F9}O                    ;; Call DB macro procedure O
~                         ;; Return
{&F9}P                    ;; Call DB macro procedure Q
{VON}                     ;; Turn video back on
```

4. Option DAYS
   Action: Macro Code

```
{VOFF}                    ;; Turn video off
{F9}W1G                   ;; Go to window #1 (data base)
{&F9}D                    ;; Call DB macro procedure D
POSITION = 'AMS' AND ;; Data base display specification
```

```
CREW = 'D' AND
TRAINER = YES
{&F9}O                  ;; Call DB macro procedure O
~                       ;; Return
{&F9}P                  ;; Call DB macro procedure Q
{VON}                   ;; Turn video back on
```

5. Option ABLE & DAYS
   Action: Macro Code

```
{VOFF}                  ;; Turn video off
{F9}W1G                 ;; Go to window #1 (data base)
{&F9}D                  ;; Call DB macro procedure D
POSITION = 'AMS' AND ;; Data base display specification
(CREW = 'A' OR
CREW = 'D') AND
TRAINER = YES
{&F9}O                  ;; Call DB macro procedure O
~                       ;; Return
{&F9}P                  ;; Call DB macro procedure Q
{VON}                   ;; Turn video back on
```

6. Option BAKER & DAYS
   Action: Macro Code

```
{VOFF}                  ;; Turn video off
{F9}W1G                 ;; Go to window #1 (data base)
{&F9}D                  ;; Call DB macro procedure D
POSITION = 'AMS' AND ;; Data base display specification
(CREW = 'B' OR
 CREW = 'D') AND
TRAINER = YES
{&F9}O                  ;; Call DB macro procedure O
~                       ;; Return
{&F9}P                  ;; Call DB macro procedure Q
{VON}                   ;; Turn video back on
```

7. Option CHARLIE & DAYS
   Action: Macro Code

```
{VOFF}                  ;; Turn video off
{F9}W1G                 ;; Go to window #1 (data base)
{&F9}D                  ;; Call DB macro procedure D
POSITION = 'AMS' AND ;; Data base display specification
(CREW = 'C' OR
 CREW = 'D') AND
 TRAINER = YES
{&F9}O                  ;; Call DB macro procedure O
~                       ;; Return
{&F9}P                  ;; Call DB macro procedure Q
{VON}                   ;; Turn video back on
```

8. Option ALL
   Action: Macro Code

```
{VOFF}                    ;; Turn video off
{F9}W1G                   ;; Go to window #1 (data base)
{&F9}D                    ;; Call DB macro procedure D
POSITION = 'AMS' AND ;; Data base display specification
TRAINER = YES
{&F9}O                    ;; Call DB macro procedure O
~                         ;; Return
{&F9}P                    ;; Call DB macro procedure Q
{VON}                     ;; Turn video back on
```

MENU AMSTCREW:

```
SELECT CREW:  ABLE       BAKER       CHARLIE       DAYS
      1=ABLE & DAYS   2=BAKER & DAYS   3=CHARLIE & DAYS   4=ALL
```

1. Option ABLE
   Action: Macro Code

```
{VOFF}                    ;; Turn video off
{F9}W1G                   ;; Go to window #1 (data base)
{&F9}D                    ;; Call DB macro procedure D
POSITION = 'AMS' AND ;; Data base display specification
CREW = 'A' AND
EXPLEVEL = 0
{&F9}O                    ;; Call DB macro procedure O
~                         ;; Return
{&F9}P                    ;; Call DB macro procedure R
{VON}                     ;; Turn video back on
```

2. Option BAKER
   Action: Macro Code

```
{VOFF}                    ;; Turn video off
{F9}W1G                   ;; Go to window #1 (data base)
{&F9}D                    ;; Call DB macro procedure D
POSITION = 'AMS' AND ;; Data base display specification
CREW = 'B' AND
EXPLEVEL = 0
{&F9}O                    ;; Call DB macro procedure O
~                         ;; Return
{&F9}P                    ;; Call DB macro procedure R
{VON}                     ;; Turn video back on
```

3. Option CHARLIE
   Action: Macro Code

```
{VOFF}                    ;; Turn video off
{F9}W1G                   ;; Go to window #1 (data base
{&F9}D                    ;; Call DB macro procedure D
POSITION = 'AMS' AND ;; Data base display specification
CREW = 'C' AND
EXPLEVEL = 0
```

```
        {&F9}O                    ;; Call DB macro procedure O
        ~                         ;; Return
        {&F9}P                    ;; Call DB macro procedure R
        {VON}                     ;; Turn video back on
```

4. Option DAYS
   Action: Macro Code

```
        {VOFF}                    ;; Turn video off
        {F9}W1G                   ;; Go to window #1 (data base)
        {&F9}D                    ;; Call DB macro procedure D
        POSITION = 'AMS' AND ;; Data base display specification
        CREW = 'D' AND
        EXPLEVEL = 0
        {&F9}O                    ;; Call DB macro procedure O
        ~                         ;; Return
        {&F9}P                    ;; Call DB macro procedure R
        {VON}                     ;; Turn video back on
```

5. Option ABLE & DAYS
   Action: Macro Code

```
        {VOFF}                    ;; Turn video off
        {F9}W1G                   ;; Go to window #1 (data base)
        {&F9}D                    ;; Call DB macro procedure D
        POSITION = 'AMS' AND ;; Data base display specification
        (CREW = 'A' OR
        CREW = 'D') AND
        EXPLEVEL = 0
        {&F9}O                    ;; Call DB macro procedure O
        ~                         ;; Return
        {&F9}P                    ;; Call DB macro procedure R
        {VON}                     ;; Turn video back on
```

6. Option BAKER & DAYS
   Action: Macro Code

```
        {VOFF}                    ;; Turn video off
        {F9}W1G                   ;; Go to window #1 (data base)
        {&F9}D                    ;; Call DB macro procedure D
        POSITION = 'AMS' AND ;; Data base display specification
        (CREW = 'B' OR
         CREW = 'D') AND
        EXPLEVEL = 0
        {&F9}O                    ;; Call DB macro procedure O
        ~                         ;; Return
        {&F9}P                    ;; Call DB macro procedure R
        {VON}                     ;; Turn video back on
```

7. Option CHARLIE & DAYS
   Action: Macro Code

```
        {VOFF}                    ;; Turn video off
        {F9}W1G                   ;; Go to window #1 (data base)
        {&F9}D                    ;; Call DB macro procedure D
```

```
POSITION = 'AMS' AND ;; Data base display specification
(CREW = 'C' OR
 CREW = 'D') AND
EXPLEVEL = 0
{&F9}O                  ;; Call DB macro procedure O
~                       ;; Return
{&F9}P                  ;; Call DB macro procedure R
{VON}                   ;; Turn video back on
```

8. Option ALL
   Action: Macro Code

```
{VOFF}                  ;; Turn video off
{F9}W1G                 ;; Go to window #1 (data base)
{&F9}D                  ;; Call DB macro procedure D
POSITION = 'AMS' AND ;; Data base display specification
EXPLEVEL = 0
{&F9}O                  ;; Call DB macro procedure O
~                       ;; Return
{&F9}P                  ;; Call DB macro procedure R
{VON}                   ;; Turn video back on
```

MENUS: AACREW, AAICREW, AATCREW, MACREW, MAICREW, MATCREW, MFBCREW, MFBICREW, MFBTCREW, MFLCREW, MFLICREW, MFLTCREW, NMFBCREW, NMFBICRE, NMFBTCRE, NMFLCREW, NMFLICRE, NMFLTCRE, MRBCREW, MRBICREW, MRBTCREW, MRLCREW, MRLICREW, MRLTCREW, NMRBCREW, NMRBICRE, NMRBTCRE, NMRLCREW, NMRLICRE, NMRLTCRE

All the above menus follow the same basic pattern as that described for the AMS series of menus. Therefore, separate entries for these menus will not be made.

MENU S:

MISSION SCHEDULE MENU

DISPLAY MISSION SCHEDULE
ADD MISSION(S) TO SCHEDULE
CHANGE MISSION SCHEDULE

1. Option DISPLAY
   Action: Go to Menu DSPLYMSN

2. Option ADD
   Action: Macro Code

```
{F9}W1G                 ;; Go to window #1 (data base)
{ESC}{ESC}              ;; Go to data base actions menu
A MISSION               ;; Add to MISSION relation
{25X}{DEL}              ;; Delete unwanted characters
```

```
       ~                    ;; Return
```

3. Option CHANGE
   Action: Go to Menu CHNGMSN

MENU DSPLYMSN:

ENTER START DATE: __________
(YY,MM,DD)

1. Option ENTER
   Action: Macro Code

```
{F9}W1G                  ;; Go to window #1 (data base)
{ESC}{ESC}               ;; Go to data base actions menu
D MISSION                ;; Display MISSION relation
{25X}{DEL}               ;; Delete unwanted characters
~~                       ;; 2 Returns
DATE GE `[%STARTDT]`     ;; Specification for which
                            missions to list
~                        ;; Return
NUMBER,TYPE,DATE,        ;; Fields to display
TAKEOFF,LAND,
SHOWTIME
```

MENU CHNGMSN:

ENTER MISSION NUMBER: ________

1. Option ENTER
   Action: Macro Code

```
{F9}W1G                  ;; Go to window #1 (data base)
{ESC}{ESC}               ;; Go to data base actions menu
E MISSION                ;; Edit MISSION relation
{25X}{DEL}               ;; Delete unwanted characters
~~~                      ;; 3 Returns
NUMBER = `[%MSNNBR]`     ;; Specification of which mission
                            to edit
~~                       ;; 2 Returns
```

MENU U:

OPERATOR UPDATE MENU

WOULD YOU LIKE TO:
ADD A RECORD
CHANGE A RECORD
DELETE A RECORD

1. Option ADD
   Action: Go to Menu ADD

2. Option CHANGE
   Action: Go to Menu CHANGE

3. Option DELETE
   Action: Go to Menu DELETE

MENU ADD:

OPERATOR ADD MENU

ENTER OPERATOR'S LAST NAME: ____________________

AVAILABILITY
1=ADD A NEW OPERATOR TO THE DATA BASE

YOUR CHOICE WILL TAKE YOU TO THE APPROPRIATE DATA BASE. TO ADD AN OPERATOR, SIMPLY TYPE IN THE APPROPRIATE INFORMATION AS IT IS REQUESTED. IF TIS IS A BRAND NEW OP AND YOU ARE SETTING UP NEW RECORDS, YOU WILL GO TO THE OPERATOR DATA BASE FIRST. AFTER YOU ARE FINISHED ENTERING THE DATE, SAVE IT, THEN QUIT (F10 SAVE/QUIT). CHOOSE ADD AGAIN BUT TYPE IN POSITION AT THE WHICH DATA BASE PROMPT, THEN HIT RETURN 3 TIMES. YOU NOW MAY ENTER THE REST OF THE OPERATOR INFORMATION.

1. Option AVAILABILITY
   Action: Macro Code

```
{F9}W1G             ;; Go to window #1 (data base)
{ESC}{ESC}          ;; Go to data base actions menu
A ABSENT            ;; Add to the ABSENT relation
{20X}{DEL}          ;; Delete unwanted characters
~~~                 ;; 3 Returns
```

2. Option ADD
   Action: Macro Code

```
{F9}W1G             ;; Go to window #1 (data base)
{ESC}{ESC}          ;; Go to data base actions menu
A OPERATOR          ;; Add to the OPERATOR relation
{20X}{DEL}          ;; Delete unwanted characters
~~~                 ;; 3 Returns
```

MENU CHANGE:

```
                         OPERATOR CHANGE MENU

      ENTER OPERATOR'S LASTNAME: ________________________

              AVAILABILITY                QUALIFICATION
              SSAN                        TRAINER QUAL
              NAME                        1=TRAINEE PRIORITY
              RANK                        2=TRAINER STRENGTHS
              CREW                        EXPERIENCE LEVEL
              OPERATOR TYPE               3=STAN/EVAL DATE
              PRIMARY POSITION
```

YOUR CHOICE WILL TAKE YOU TO THE APPROPRIATE DATA BASE. TO CHANGE A RECORD (EDIT), SIMPLEY MARK THE APPROPRIATE RECORD USING THE F7 FUNCTION KEY, PRESS ESC TWICE, THEN PRESS 'E'. THE RECORD CAN NOW BE CHANGED
**** NOTE, IF YOU CHANGE THE SSAN, YOU MUST CHANGE IT IN ALL RELATIONS

1. Option AVAILABILITY
   Action: Macro Code

```
{F9}W1G              ;; Go to window #1 (data base)
{&F9}6               ;; Call DB macro procedure 6
```

2. Option SSAN
   Action: Macro Code

```
{F9}W1G              ;; Go to window #1 (data base)
{ESC}{ESC}           ;; Go to data base actions menu
D                    ;; Display data base
```

3. Option NAME
   Action: Macro Code

```
{F9}W1G              ;; Go to window #1 (data base)
{&F9}4               ;; Call DB macro procedure 4
```

4. Option RANK
   Action: Macro Code (same as Option NAME)

5. Option CREW
   Action: Macro Code (same as Option NAME)

6. Option OPERATOR TYPE
   Action: Macro Code (same as Option NAME)

7. Option PRIMARY POSITION
   Action: Macro Code

```
{F9}W1G              ;; Go to window #1 (data base)
{&F9}5               ;; Call DB macro procedure 5
```

8. Option QUALIFICATION
   Action: Macro Code (same as Option PRIMARY POSITION)

9. Option TRAINER QUAL
   Action: Macro Code (same as Option PRIMARY POSITION

10. Option TRAINEE PRIORITY
   Action: Macro Code (same as Option PRIMARY POSITION

11. Option TRAINER STRENGTHS
   Action: Macro Code (same as Option PRIMARY POSITION

12. Option EXPERIENCE LEVEL
   Action: Macro Code (same as Option PRIMARY POSITION

13. Option STAN/EVAL DATE
   Action: Macro Code (same as Option PRIMARY POSITION

MENU DELETE:

OPERATOR DELETE MENU

ENTER OPERATOR'S LASTNAME: ____________________

AVAILABILITY
1=ALL OPERATOR RECORDS

YOUR CHOICE WILL TAKE YOU TO THE APPROPRIATE DATA BASE. TO DELETE A
RECORD: 1) MARK THE APPROPRIATE RECORD USING THE F7 FUNCTION KEY
2) PRESS 'ESC' 2 TIMES
3) PRESS '1'
4) PRESS 'RETURN' 2 TIMES
5) PRESS 'ESC' 2 TIMES
6) PRESS '6'
7) PRESS 'RETURN' 3 TIMES

1. Option AVAILABILITY
   Action: Macro Code (same as Option AVAILABILITY above)

2. Option ALL OPERATOR RECORDS
   Action: Macro Code (same as Option PRIMARY POSITION above.

MENU C:

MISSION COMPLETION MENU

UPDATE MISSION HISTORY DATA BASE
1=UPDATE OPERATOR FLIGHT HISTORY DATA BASE
2=UPDATE 30/90 DAY FLIGHT HOUR TOTALS
30 DAY UPDATE
90 DAY UPDATE
ADD INDIVIDUAL HOURS (E-3A,C-130,ETC.)
RETURN TO MAIN MENU

1. Option UPDATE MISSION HISTORY DATA BASE
   Action: Macro Code

```
{F9}W1G                  ;; Go to window #1 (data base
{ESC}{ESC}               ;; Go to data base actions menu
A MSNHISTY               ;; Add to MSNHISTY relation
{15X}{DEL}               ;; Delete unwanted characters
~~~                      ;; 3 Returns
```

2. Option UPDATE OPEATOR FLIGHT HISTORY DATA BASE
   Action: Go to Menu OPHISTY

3. Option 30 DAY UPDATE
   Action: Macro Code

```
{VOFF}                   ;; Turn video off
{&HOME}USR THIRTY~       ;; Open window with THIRTY.SSF
                            spreadsheet
{F9}W1G                  ;; Go to window #1 (data base)
{ESC}{ESC}               ;; Go to data base actions menu
S                        ;; Sort
{VON}                    ;; Turn video on
{&F9}1                   ;; Call DB macro procedure 1
{F9}W3G                  ;; Go to window #3 (THIRTY.SSF)
{VOFF}                   ;; Turn video off
{F2}H4~                  ;; Put cursor in space H4 in
                            preparation for data transfer
{&F9}H                   ;; Call SS macro procedure H
{&HOME}USR HOURS3~       ;; Open window with HOURS3.SSF
                            spreadsheet
{F2}A4~                  ;; Put cursor in space A4 in
                            preparation of data transfer
{&F9}R                   ;; Call SS macro procedure R
{F9}W1G                  ;; Go to window #1 (data base)
{ESC}{ESC}               ;; Go to data base actions menu
U                        ;; Update
{&F9}2                   ;; Call DB macro procedure 2
{F9}W4G                  ;; Go to window #4 (HOURS3.SSF)
{F2}A4~                  ;; Position cursor in preparation
                            to delete data
{F10}WRE.                ;; Erase data from HOURS3.SSF
{RIGHT}{END}{DOWN}~
{&F10}~R                 ;; Save 'clean' file (HOURS3.SSF)
{&END}Y                  ;; Close window
{F9}W3G                  ;; Go to window #3 (THIRTY.SSF
{&END}Y                  ;; Close window
{VON}                    ;; Turn video on
{^F10}C                  ;; Go to Menu C
```

4. Option 90 DAY UPDATE
   Action: Macro Code

```
{VOFF}                   ;; Turn video off
{&HOME}USR NINETY~       ;; Open window with NINETY.SSF
```

```
                                       spreadsheet
     {F9}W1G                        ;; Go to window #1 (data base
     {ESC}{ESC}                     ;; Go to data base actions menu
     S                              ;; Sort
     {VON}                          ;; Turn video on
     {&F9}1                         ;; Call DB macro procedure 1
     {F9}W3G                        ;; Go to window #3 (NINETY.SSF
     {VOFF}                         ;; Turn video off
     {F2}H4~                        ;; Put cursor in space H4 in
                                       preparation for data transfer
     {&F9}H                         ;; Call SS macro procedure H
     {&HOME}USR HOURS9~             ;; Open window with HOURS9.SSF
                                       spreadsheet
     {F2}A4~                        ;; Put cursor in space A4 in
                                       preparation of data transfer
     {&F9}R                         ;; Call SS macro procedure R
     {F9}W1G                        ;; Go to window #1 (data base)
     {ESC}{ESC}                     ;; Go to data base actions menu
     U                              ;; Update
     {&F9}3                         ;; Call DB macro procedure 3
     {F9}W4G                        ;; Go to window #4 (HOURS9.SSF)
     {F2}A4~                        ;; Position cursor in preparation
                                       to delete data
     {F10}WRE.                      ;; Erase data from HOURS9.SSF
     {RIGHT}{END}{DOWN}~
     {&F10}~R                       ;; Save "clean" file (HOURS9.SSF
     {&END}Y                        ;; Close window
     {F9}W3G                        ;; Go to window #3 (NINETY.SSF)
     {&END}Y                        ;; Close window
     {VON}                          ;; Turn video on
     {^F10}C                        ;; Go to Menu C
```

5. Option ADD INDIVIDUAL HOURS
   Action: Macro Code

```
     {F9}W1G                        ;; Go to window #1 (data base)
     {ESC}{ESC}                     ;; Go to data base actions menu
     A OPHISTY                      ;; Add to OPHISTY relation
     {15X}{DEL}                     ;; Delete unwanted characters
     ~~~                            ;; 3 Returns
```

6. Option RETURN
   Action: Go to Menu N

MENU OPHISTY:

ENTER MISSION NUMBER: ____________

1. Option ENTER
   Action: Macro Code

```
     {&HOME}USR [%MISSION]~     ;; Open window with entered
```

```
                                    mission crew spreadsheet
{F2}A5~                 ;; Position cursor at position A5
{&HOME}USR MSNDONE~     ;; Open window with MSNDONE.SSF
                           spreadsheet
{&F9}U                  ;; Call SS macro procedure U
{F9}W1G                 ;; Go to window #1 (data base)
{ESC}{ESC}              ;; Go to data base actions menu
C OPHISTY               ;; Copy into OPHISTY relation
{15X}{DEL}              ;; Delete unwanted characters
~                       ;; Return
F E MSNDONE.SSF         ;; Copy data from MSNDONE.SSF to
                           OPHISTY relation
~~~                     ;; 3 Returns
{F9}W4G                 ;; Go to window #4 (MSNDONE.SSF)
{F2}A4~                 ;; Position cursor at position A4
                           in preparation for clearing data
{F10}WRE.               ;; Erase data from MSNDONE.SSF
{4X}{RIGHT}
{END}{DOWN}~
{&F10}~R                ;; Save 'clear' spreadsheet
                           (MSNDONE.SSF)
{&END}Y                 ;; Close window #4 (MSNDONE.SSF)
{F9}W3G                 ;; Go to window #3 ([%MISSION].SSF)
{&END}Y                 ;; Close window #3
{^F10}C                 ;; Go to Menu C
```

MENU MISC:

MISCELLANEOUS MENU

SV-83
FLIGHT PHYSICAL
LIFE SUPPORT
PHYSIOLOGICAL TRAINING

1. Option SV-83
   Action: Macro Code

```
{F9}W1G                 ;; Go to window #1 (data base)
{&F9}X                  ;; Call DB macro procedure X
```

2. Option FLIGHT PHYSICAL
   Action: Macro Code (same as Option SV-83)

3. Option LIFE SUPPORT
   Action: Macro Code (same as Option SV-83)

4. Option PHYSIOLOGICAL TRAINING
   Action: Macro Code (same as Option SV-83)

MENU F: (FLIGHT ORDERS)

FLIGHT ORDERS

ENTER MISSION NUMBER: ________

HAVE YOU WORKED ON THESE
ORDERS BEFORE?
YES NO

1. Option ENTER
   Action: Go to Option YES after typing mission number

2. Option YES
   Action: Macro Code

```
{&HOME}UWR              ;; Open window with [%MISSION].WPF
                           word processing file
{^F10}I                 ;; Go to Menu I
```

3. Option NO
   Action: Macro Code

```
{&HOME}UWC              ;; Open window with [%MISSION].WPF
                           word processing file
~~                      ;; 2 Returns
{3X}{UP}{&F3}           ;; Delete Document Title line
{&HOME}USR ORDERS~      ;; Open window with ORDERS.SSF
                           spreadsheet
{&HOME}USR [%MISSION]~    ;; Open window with
                             [%MISSION].SSF spreadsheet
{F2}C1~                 ;; Position cursor at position C1
{F9}W4G                 ;; Go to window #4 (ORDERS.SSF)
{&F9}K                  ;; Call SS macro procedure K
{F9}W5G                 ;; Go to window #5 ([%MISSION].SSF)
{&END}Y                 ;; Close window #5
{F9}W3G                 ;; Go to window #3 ([%MISSION].WPF)
{&F9}F                  ;; Call WP macro procedure F
```

MENU G:

ENTER THE EXPECTED LAND DATE

____
AND HIT RETURN

1. Option ENTER
   Action: Macro Code

```
{ESC}                   ;; Go to [%MISSION].WPF file
[%LAND]~                ;; Insert expected land date
{&F9}G                  ;; Call WP macro procedure G
```

MENU H:

ENTER THE DATE AND TAKEOFF TIME IN
THE FOLLOWING FORMAT: 15 MAR 87/ 0500Z

HIT RETURN

1. Option ENTER
   Action: Macro Code

```
{ESC}                   ;; Go to [%MISSION].WPF file
[%TAKEOFF]~             ;; Insert expected takeoff time
{&F9}H                  ;; Call WP macro procedure H
```

MENU I:

ENTER TODAY'S DATE

HIT RETURN

1. Option ENTER
   Action: Macro Code

```
{ESC}                   ;; Go to [%MISSION].WPF file
[%TODAY]~               ;; Insert today's date
{60X}{RIGHT}{UP}        ;; Position cursor
{&F9}J                  ;; Call WP macro procedure J
```

MENU J:

ENTER THE ORDER NUMBER

HIT RETURN

1. Option ENTER
   Action: Macro Code

```
{ESC}                   ;; Go to [%MISSION].WPF file
[%ORDNBR]~              ;; Insert Order Number
{13X}{RIGHT}            ;; Position cursor
6916ESS~                ;; Insert 6916ESS
{13X}{RIGHT}            ;; Position cursor
HELLENIKON AB, GR~      ;; Insert HELLENIKON AB, GR
{50X}{RIGHT}            ;; Position cursor
C.T. FRENCH, LTCOL, USAF~   ;; Enter Ops Officer's name
{50X} {RIGHT}           ;; Position cursor
OPERATIONS OFFICER      ;; Insert OPERATIONS OFFICER
{^F10}K                 ;; Go to Menu K
```

MENU K:

WOULD YOU LIKE TO EXAMINE THE ORDERS OR MAKE CHANGES?

YES NO

1. Option YES
   Action: Go to Menu ORDCHG

2. Option NO
   Action: Go to Menu PRINT

MENU ORDCHG:

WHEN YOU ARE DONE, PRESS CTRL/F10 THEN K

HIT RETURN TO CONTINUE

1. Option CONTINUE
   Action: Macro Code

```
{ESC}                  ;; Go to word processing file
```

MENU PRINT:

FLIGHT ORDERS PRINT MENU

WOULD YOU LIKE TO PRINT THE FLIGHT ORDERS?

YES NO

1. Option YES
   Action: Go to Menu PRINT2

2. Option NO
   Action: Go to Menu ORDCHG

MENU PRINT2:

INSERT ORDERS IN THE PRINTER AND HIT RETURN WHEN READY

1. Option INSERT
   Action: Macro Code

```
{F9}W3G          ;; Go to window #3 (word processing
                    file -- flight orders)
{&F2}            ;; Print Orders
{F9}W4G          ;; Go to window #4 (spreadsheet)
{&END}Y          ;; Close window #4
{F9}W3G          ;; Go to window #3
{&END}Y          ;; Close window #3
{^F10}N          ;; Go to Menu N (Main Menu)
```

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VITA

Captain Thomas J. Kopf was born on 3 September 1955 in Kohler, Wisconsin. He graduated from Kohler High School in 1974 and received Bachelor of Science degrees in Economics and Management and his commission from the US Air Force Academy in May 1978. In Dec 1978, he graduated from the AF School of Applied Cryptologic Sciences at Goodfellow AFB, Texas. From Jan 1979 until May 1981, Captain Kopf served as a Flight Commander and Chief of Exploitation Management at the 6950th Electronic Security Group, RAF Chicksands, England. From May 1981 to Jun 1983, he served as the Chief of Defensive Operations, Chief of Offensive Operations, and Deputy Commander for Operations at the 6910 Electronic Security Wing, Lindsey Air Station, Germany. From Germany, Captain Kopf served a tour with the 6916th Electronic Security Squadron, Hellenikon AB, Greece, from Jul 1983 to Jul 1985. While at the 6916ESS, he served as the Chief of Mission Management, Chief of Operations Support, Chief of Computer Resources, Chief of Operations Production, and Operations Officer. In Aug 1985, Captain Kopf entered the School of Engineering, Air Force Institute of Technology.

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